













# A KEY

TO THE

## WESTERN CALCULATOR,

CONTAINING

THE SOLUTION OF ALL THE EXAMPLES AND  
QUESTIONS FOR EXERCISE,

WITH REFERENCE TO THE PAGES WHERE THEY STAND.

TO WHICH IS ADDED,

SOME USEFUL RULES,

DESIGNED CHIEFLY TO FACILITATE THE LABOR OF TEACHERS; AND  
ASSIST SUCH AS HAVE NOT THE OPPORTUNITY OF A TUTOR'S AID.

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BY JOHN ARMSTRONG, A. M.

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## ARITHMETICAL MARKS AND SIGNS.

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- $=$  The sign of equality, and is pronounced *equal*.
- $+$  The sign of addition, pronounced *added to*.
- $-$  The sign of subtraction, pronounced *subtracted by*.
- $\times$  The sign of multiplication, pronounced *multiplied by*.
- $\div$  The sign of division, pronounced *divided by*.
- $:::$  The sign of proportion, pronounced *is to, so is, to*.
- $\propto$  Sign of difference, pronounced *the difference between*.
- $\sqrt{\phantom{x}}$ , or  $\frac{1}{2}$ , The sign of the square root.
- $\sqrt[3]{\phantom{x}}$ , or  $\frac{1}{3}$ , The sign of the cube root.
- $7^2$ , Denotes that the number 7 is to be squared.
- $8^3$ , Denotes that the number 8 is to be cubed.
- $\therefore$  Or,
- Vinculum, and ( ) parenthesis.

### *Examples.*

- $12+7=19$ ; twelve added to 7 is equal to nineteen.
- $23-8=15$ ; twenty-three subtracted by eight, equal fifteen.
- $9\times 8=72$ ; nine multiplied into eight equal seventy-two.
- $24\div 3=8$ ; twenty-four divided by three equal eight.

Sometimes the division of one number by another, is expressed in the manner of a vulgar fraction; thus  $\frac{27}{9}=3$ , twenty-seven divided by nine equal three. Multiplication is also frequently denoted by this mark. thus  $7.12=84$ , seven into twelve equal eighty-four.

- $6:9::8:12$ ; as 6 is to 9 so is 8 to 12.
- $A \propto Z$ ; read the difference between A and Z.
- $\sqrt{81}=9$ , or  $81^{\frac{1}{2}}=9$ ; the square root of 81 equals 9.
- $10:100::1:10$ ; as 10 is to 100 that is as 1 is to 10.

A vinculum is placed over several quantities to denote that they are to be considered as one simple quantity; a parenthesis is often used for the same purpose.

# KEY

TO THE

## WESTERN CALCULATOR.

---

### NUMERATION.

Page 8.

*Example* 1.      16                      2.      49

Page 9.

3. 385      4. 2610      5. 64536      6. 253842  
7. 5600006      8. 90000305      9. 829006002

1. Five.
2. Seventeen.
3. Thirty-five.
4. Four hundred and fifty-eight.
5. Six thousand, eight hundred and twenty-nine.
6. Seventy-two thousand, three hundred and forty-eight.
7. Three hundred and eighty-four thousand, seven hundred and twenty-one.
8. Two millions, six hundred and eighty-three thousand, two hundred.
9. Fifty millions, six hundred and seventy-eight thousand and twenty-four.

### ADDITION.

Page 10.

2. 1581366	3. 2468727092
4. 2284038452	5. 2263764650
6. 2968194198	7. 5831333360
8. 5075433465	9. 9750563355
10. 36447723180651	11. 3847099705067

## SUBTRACTION.

*Application.*

Page 11.

1. 125	2. 129	dolls.	barrels	dolls.
23	654	3. A 125	4. 60 for	480
16	8070	B 286	75	675
2060	10000	C 29	220	2200
8009574	4000000	D 672	126	1386
6				
	<u>4018853</u>	<u>\$ 1112</u>	<u>481 bbls.</u>	<u>4741 dolls.</u>
8011804				

5. 297	6. 1209	7. 1811	dolls.
125	476	21	
754	8017	<u>      </u>	8. George 3560
127	3119221	1832	William 3240
245	<u>      </u>		Samuel 2850
<u>      </u>	3128923		Henry 2555
1548			Thomas 2226
			<u>      </u>
			14431

## SUBTRACTION.

Page 12.

3. 44064062638	4. 5390534442
5. 56053355680	6. 00000001

*Application.*

1. 1818	2. 5648	barrels
1777	3460	3. 1260
<u>      </u>	<u>      </u>	
41	2188	sells to A 320
		B 435
		<u>      </u>
		sold in all 755
		<u>      </u>
		unsold 505
4. 6000	cents	cents
600	5. 145	35 penknife
<u>      </u>	75	25 slate
5400	40	64 paper
	<u>      </u>	30 apples
	given him 260	<u>      </u>
	given away 154	154
	<u>      </u>	
	left 106	

## MULTIPLICATION.

Case 1. Page 13.

$$\begin{array}{r} 2. \quad 24639576 \\ \quad \quad 4 \\ \hline 98558304 \end{array}$$

$$\begin{array}{r} 3. \quad 3675432568 \\ \quad \quad \quad 8 \\ \hline 29403460544 \end{array}$$

Page 14.

$$\begin{array}{r} 5. \quad 476824753 \\ \quad \quad 5 \\ \hline 2384123765 \end{array}$$

$$\begin{array}{r} 6. \quad 964703024 \\ \quad \quad \quad 6 \\ \hline 5788218144 \end{array}$$

$$\begin{array}{r} 7. \quad 74020005 \\ \quad \quad \quad 8 \\ \hline 592160040 \end{array}$$

$$\begin{array}{r} 8. \quad 2901946808 \\ \quad \quad 9 \\ \hline 26117521272 \end{array}$$

$$\begin{array}{r} 9. \quad 246354276 \\ \quad \quad \quad 11 \\ \hline 2709897036 \end{array}$$

Case 2.

$$\begin{array}{r} 2. \quad \text{Mult. } 68523047653 \\ \quad \quad \text{by } 2367 \end{array}$$

$$\begin{array}{r} 479661333571 \\ 411138285918 \\ 205569142959 \\ 137046095306 \\ \hline 162194053794651 \end{array}$$

Page 15.

$$\begin{array}{r} 3. \quad \text{Mult. } 5221 \\ \quad \quad \text{by } 145 \\ \hline 26105 \\ 20884 \\ 5221 \\ \hline 757045 \end{array}$$

$$\begin{array}{r} 4. \quad \text{Mult. } 23430 \\ \quad \quad \text{by } 230 \\ \hline 702900 \\ 4686 \\ \hline 5388900 \end{array}$$

$$\begin{array}{r} 5. \quad \text{Mult. } 3800920 \\ \quad \quad \text{by } 80750 \\ \hline 190046000 \\ 2660644 \\ 30407360 \\ \hline 306924290000 \end{array}$$

$$\begin{array}{r} 6. \quad \text{Mult. } 89536925 \\ \quad \quad \text{by } 735 \\ \hline 447684625 \\ 268610775 \\ 626758475 \\ \hline 65809639875 \end{array}$$

$$\begin{array}{r} 7. \quad \text{Mult. } 78965987 \\ \quad \quad \text{by } 5893 \\ \hline 236897961 \\ 710693883 \\ 631727896 \\ 394829935 \\ \hline 465346561391 \end{array}$$

$$\begin{array}{r} 8. \quad 1.15 \\ \quad \quad 75 \end{array}$$

$$\begin{array}{r} 9. \quad 3950 \\ \quad \quad 29 \\ \hline 35550 \\ 7900 \\ \hline \$1145.50 \end{array}$$

$$\begin{array}{r} 10. \quad 40 \\ \quad \quad 12 \\ \hline 480 \text{ pence} \end{array}$$

$$\begin{array}{r} 575 \\ 805 \\ \hline \$86.25 \end{array}$$

## MULTIPLICATION.

## Case 3. Page 15.

$$\begin{array}{r} 2. \text{ Mult. } 871075 \\ \text{by } 21 \quad 3 \\ \hline \end{array}$$

$$\begin{array}{r} 2613225 \\ 7 \\ \hline \end{array}$$

$$\hline 18292575$$

$$\begin{array}{r} 3. \text{ Mult. } 2453642 \\ \text{by } 36 \quad 6 \\ \hline \end{array}$$

$$\begin{array}{r} 14721852 \\ 6 \\ \hline \end{array}$$

$$\hline 88331112$$

$$\begin{array}{r} 4. \text{ Mult. } 43102 \\ \text{by } 64 \quad 8 \\ \hline \end{array}$$

$$\begin{array}{r} 344816 \\ 8 \\ \hline \end{array}$$

$$\hline 2758528$$

$$\begin{array}{r} 5. \text{ Mult. } 23645 \text{ by } 144 \\ 12 \\ \hline \end{array}$$

$$\begin{array}{r} 283740 \\ 12 \\ \hline \end{array}$$

$$\hline 3404880$$

$$\begin{array}{r} 6. \text{ Mult. } 12071 \text{ by } 99 \\ 9 \\ \hline \end{array}$$

$$\begin{array}{r} 108639 \\ 11 \\ \hline \end{array}$$

$$\hline 1195029$$

## Case 4. Page 16.

$$\begin{array}{r} 2. \text{ Mult. } 3600 \\ \text{by } 400 \\ \hline \end{array}$$

$$\hline 1440000$$

$$\begin{array}{r} 3. \text{ Mult. } 44000 \\ \text{by } 550000 \\ \hline \end{array}$$

$$\begin{array}{r} 220 \\ 220 \\ \hline \end{array}$$

$$\hline 24200000000$$

$$\begin{array}{r} 4. \text{ Mult. } 663000 \\ \text{by } 60000 \\ \hline \end{array}$$

$$\hline 39780000000$$

NOTE. *Ex.* 1.  $200 \times 10 = 2000$   
 2.  $462 \times 100 = 46200$   
 3.  $879 \times 1000 = 879000$

*Application.*

$$\begin{array}{r} 1. \quad 15 \\ \quad 25 \\ \hline \end{array}$$

$$\begin{array}{r} 75 \\ 30 \\ \hline \end{array}$$

$$\text{dolls. } 375$$

$$\begin{array}{r} 2. \quad 125 \\ \quad 43 \\ \hline \end{array}$$

$$\begin{array}{r} 375 \\ 500 \\ \hline \end{array}$$

$$\text{dolls. } 53,75$$

$$\begin{array}{r} 3. \quad 32 \text{ cents} \\ \quad 440 \\ \hline \end{array}$$

$$\begin{array}{r} 1280 \\ 128 \\ \hline \end{array}$$

$$\text{dolls. } 140,80$$

$$\begin{array}{l} 4. \quad 60 \times 125 = 75,00 \text{ wheat} \\ \quad 40 \times 85 = 34,00 \text{ rye} \\ \quad 34 \times 50 = 17,00 \text{ corn} \\ \hline \end{array}$$

$$\hline \$126,00 \text{ amount}$$

$$\begin{array}{r} 5. \quad 100 \\ \quad 10 \\ \hline \end{array}$$

$$\begin{array}{r} 1000 \text{ dimes} \\ 10 \\ \hline \end{array}$$

$$\hline 10000 \text{ cents}$$

$$6. \quad 32$$

$$\text{sub. } 20 \times 24 = 480$$

$$\hline 12 \times 18 = 216$$

$$\hline \text{panes } 696$$

Page 17.

7. 7525	8. dolls. 250 A's	\$ 250 A
125	3	750 B
<u>37625</u>	<u>750 B's</u>	<u>3000 C</u>
15050	4	4000 altogether
<u>7525</u>	<u>3000 C's</u>	
940625		

DIVISION.

Case 1.

3. 4)4756394344	4. 5)97036142	5. 8)37846210
<u>1189098586</u>	<u>19407228<math>\frac{2}{5}</math></u>	<u>4730776<math>\frac{2}{5}</math></u>
6. 12)64381259	7. 6)3824966	8. 7)46825486
<u>5365104<math>\frac{11}{12}</math></u>	<u>637494<math>\frac{2}{6}</math></u>	<u>6689355<math>\frac{1}{7}</math></u>
	9. 9)8297463813	
	<u>921940423<math>\frac{6}{9}</math></u>	

Case 2. Page 13.

divisor	dividend	quot.	4. 735)47989536925(65291886 quotient
3. 64) 29687624	( 463869	4410	735
256	64	<u>3839</u>	<u>326459435*</u>
<u>408</u>	<u>1855476</u>	<u>3675</u>	<u>195875659</u>
384	2783214	<u>2145</u>	<u>457043209</u>
<u>247</u>	<u>29687616</u>	<u>1470</u>	<u>47989536925 proof</u>
192	8 rem.	<u>6753</u>	
<u>556</u>	<u>29687624 proof</u>	<u>6615</u>	
512		<u>1386</u>	*Add in the re-
<u>442</u>		<u>735</u>	mainder as you multi-
384		<u>6519</u>	ply when working the
<u>584</u>		<u>5880</u>	proof.
576		<u>6392</u>	
8 rem.		<u>5880</u>	
		<u>5125</u>	
		<u>4410</u>	
		<u>715 rem.</u>	

## Page 18.

5. 2359)4917968967 ( 2084768 6. 671)5374608 ( 8009  
 4718 2359 5368 671

<u>19996</u>	<u>18762917</u>	<u>6608</u>	<u>8018</u>
<u>13872</u>	<u>10423845</u>	<u>6039</u>	<u>56069</u>
	<u>6254306</u>		<u>48059</u>
<u>11248</u>	<u>4169537</u>	<u>569</u>	
<u>9436</u>			<u>5374608</u>

4917968967 proof

18129  
16513

16166  
14154

20127  
18872

1255 rem.

7. 175296 ) 19842712000 ( 113195 8. 108 ) 5704392 ( 52818  
 175296 175296 540 108

<u>231311</u>	<u>679170</u>	<u>304</u>	<u>422552</u>
<u>175296</u>	<u>1018763</u>	<u>216</u>	<u>528184</u>
	<u>226392</u>		

<u>560152</u>	<u>565976</u>	<u>883</u>	<u>5704392</u>
<u>525888</u>	<u>792373</u>	<u>864</u>	

113195

<u>342640</u>	<u>19842712000</u>
<u>175296</u>	

1673440  
1577664

957760

876480

81280

199

108

912

864

48

## Case 4. Page 19.

2. 6|00)876|54 3. 8|0)2834|7 4. 16|00)1370|00(85  
 128

146 54 rem.

354 27 rem.

90

80

1000 rem.

## NOTE.

2. 1|00)256|54 3. 1|000)876|029 4. 1|0000)80|0000

or 256 quot. 54 rem.

or 876 quot. 29 rem.

or 80 quot.

*Application.*

1. 855)4275(5 boys  
 4275



Page 20.

$$\begin{array}{r} 2. \quad 28)2072(74 \\ \underline{196} \\ 112 \\ \underline{112} \\ - \end{array}$$

$$\begin{array}{r} 3. \quad 75)45000(600 \\ \underline{450} \\ 00 \end{array}$$

$$\begin{array}{r} 4. \quad 8164 \\ \underline{10 \text{ subtract}} \end{array}$$

$$\begin{array}{r} 27)8154(302 \\ \underline{81} \end{array}$$

54

54

5. Here begin with the  
150 and work backwards.

thus 5)150

30

12 subtract

2)18

9 Ans.

6. 13440 dollars

$\frac{1}{4}$  = 3360 eldest son's share

$\frac{1}{5}$  = 2688 2d son's "

$\frac{1}{6}$  = 2240 3d son's "

$\frac{1}{7}$  = 1920 4th son's "

$\frac{1}{8}$  = 1680 5th son's "

11888 sum of 5 shares

then 13440

11888 subtract

1552 6th son's share

$$\begin{array}{r} 7. \quad 72064)5190048(72 \\ \underline{504588} \end{array}$$

144168

144168

8. Because A has 10 cents per day more than B, and B 10 cents per day more than C, it is evident that A will get in all 8 dollars more than C, and B 4 dollars more than C, which together is 12 dollars.

then from 288

take 12

Divide by the number of persons 3)216

72 C's share

consequently 76 B's share

and 80 A's share

$$\begin{array}{r} 9. \quad \text{half Eagle} \quad 500 \\ \text{half a dollar} \quad 50 \\ \text{quarter dollar} \quad 25 \\ \hline \end{array}$$

575 cents

$$\begin{array}{r} 575)1437,50(250 \\ \underline{1150} \end{array}$$

2875

2875

10. Captain 6 shares. Then 5|0)455|0

Mate 4 "

Seamen 40 "

dolls. 91 one seaman's share

Now  $91 \times 6 = 546$  Capt. share

And  $91 \times 4 = 364$  mate's share

No. of shares 50

## FEDERAL MONEY.

ADDITION. Page 22

2. Dolls. 19320,43

3. Dolls. 204588,00 $\frac{1}{2}$ 

SUBTRACTION.

2. Dolls. 325216,94 $\frac{1}{4}$ 3. Dolls. 126723,53 $\frac{3}{4}$ 

MULTIPLICATION. Page 23.

2. Dolls. 15823,50

3. Dolls. 57408,79 $\frac{1}{2}$ 

DIVISION.

2. Dolls. 726,55

3. Dolls. 10343,79 $\frac{1}{8}$ 

## PROMISCUOUS QUESTIONS.

*Quest. 1.*  $E d d c m$   
 25,0,0,0,0  
 6,2,0,0,0  
 8,0,0  
 7,5,5

---

 31,3,5,5,5
Or, \$ 313 55 $\frac{1}{2}$  cts.

3. Sugar \$ 39,87 $\frac{1}{2}$   
 Coffee 22,18 $\frac{3}{4}$   
 Tea 2,12 $\frac{1}{2}$

---

 \$ 64,18 $\frac{3}{4}$ 

5. Lent \$ 1000,00

Received at  $\left\{ \begin{array}{l} 160,25 \\ 285,66\frac{1}{2} \\ 300,28\frac{3}{4} \end{array} \right.$   
 sundry pay'ts.

---

 Received in all \$ 746,20 $\frac{1}{4}$ 


---

 Unpaid \$ 253,79 $\frac{3}{4}$ 

\* 8. \$17,37 $\frac{1}{2}$   
 132

---

 3474  
 5211  
 173766

---

 \$ 2293,50
*Dolls.*

2. 1055 in notes  
 260 gold  
 3650 silver  
 250 cents

---

 \$ 4967,50

4. From \$ 645,95 $\frac{3}{4}$   
 Take 350,00

---

 \$,295,95 $\frac{3}{4}$ 

6. \$ 102,19  
 Mult. by 120

---

 \$ 12262,80

7. Dolls. 4,50  
 16

---

 \$ 72,00

9. 5)6022,50

---

 \$ 1204,50

Page 23.

$$\begin{array}{r}
 10. \quad 18)252.90(14.05 \\
 \underline{18} \\
 72 \\
 \underline{72} \\
 90
 \end{array}$$

$$\begin{array}{r}
 11. \quad 45)22.50(50 \text{ cts.} \\
 \underline{225} \\
 0
 \end{array}$$

Page 24.

$$12. \quad 25)15555,50(622d. 22c$$

COMPOUND ADDITION.

ENGLISH MONEY. Page 25.

$$2. \quad \text{£}136739 \text{ 6 } 3\frac{1}{2} \qquad 3. \quad \text{£}15725 \text{ 11 } 11\frac{1}{2}$$

TROY WEIGHT.

$$\begin{array}{rcl}
 \text{lb. oz. dwt. gr.} & & \text{lb. oz. dwt. gr.} \\
 2. \quad 22 \quad 7 \quad 6 \quad 6 & & 3. \quad 33 \quad 0 \quad 9 \quad 19
 \end{array}$$

AVOIRDUPOIS WEIGHT. Page 26.

$$\begin{array}{rcl}
 T. \text{ cwt. qr. lb. oz. dr.} & & T. \text{ cwt. qr. lb. oz. dr.} \\
 1. \quad 128 \quad 12 \quad 1 \quad 18 \quad 14 \quad 10 & & 2. \quad 2921 \quad 3 \quad 0 \quad 9 \quad 0 \quad 8
 \end{array}$$

APOTHECARIES' WEIGHT.

$$\begin{array}{rcl}
 \text{lb. oz. dr. sc. gr.} & & \text{lb. oz. dr. sc. gr.} \\
 1. \quad 24 \quad 4 \quad 5 \quad 2 \quad 16 & & 2. \quad 220 \quad 2 \quad 0 \quad 2 \quad 10
 \end{array}$$

CLOTH MEASURE.

$$\begin{array}{rcl}
 Yds. \text{ qr. na.} & E. Fl. \text{ qr. na.} & E. Fr. \text{ qr. na.} \\
 1. \quad 215 \quad 2 \quad 0 & 2. \quad 173 \quad 0 \quad 0 & 3. \quad 128 \quad 4 \quad 0 \\
 & E. En. \text{ qr. na.} & \\
 & 4. \quad 221 \quad 0 \quad 2
 \end{array}$$

LONG MEASURE. Page 27.

$$\begin{array}{rcl}
 \text{deg. m. fur. po. yd. ft. in. bc.} & L. \text{ M. fur. yds. ft. in.} & \\
 1. \quad 207 \quad 27 \quad 5 \quad 6 \quad 1 \quad 0 \quad 4 \quad 0 & 2. \quad 13 \quad 2 \quad 3 \quad 167 \quad 2 \quad 10 &
 \end{array}$$

LAND MEASURE. Page 28.

$$\begin{array}{rcl}
 A. \text{ R. P.} & A. \text{ R. P.} & A. \text{ R. P.} \\
 1. \quad 161 \quad 1 \quad 29 & 2. \quad 2134 \quad 2 \quad 23 & 3. \quad 1999 \quad 2 \quad 32
 \end{array}$$

CUBIC, OR SOLID MEASURE.

$$\begin{array}{rcl}
 Co. \text{ ft. in.} & T. \text{ ft. in.} & T. \text{ ft. in.} \\
 1. \quad 26 \quad 4 \quad 1407 & 2. \quad 21 \quad 16 \quad 1542 & 3. \quad 271 \quad 26 \quad 1294
 \end{array}$$

## TIME. Page 29.

	Y.	mo.	d.	h.	mi.	sec.		Y.	d.	h.	mi.	sec.
1.	104	2	26	13	23	27	2.	14	240	4	4	33

## MOTION.

	sig.	deg.	mi.	sec.		sig.	°	'	"
1.	9	16	9	17	2.	10	12	45	23

## LIQUID MEASURE. Page 30.

	T.	hhd.	gal.	qt.	pt.		T.	hhd.	gal.
1.	20	0	15	3	1	2.	79	0	11

## DRY MEASURE.

	bu.	P.	qt.		bu.	P.	qt.		bu.	P.	qt.
1.	175	2	3	2.	1553	3	4	3.	41920	0	7

## COMPOUND SUBTRACTION.

## Page 31.

	T.	cwt.	qr.	lb.	oz.	dr.		mi.	fur.	P.	ft.	in.	bc.
2.	156	19	0	22	2	6	3.	124	5	34	4	7	2

	bu.	P.	qt.	pt.		D.	h.	mi.	sec.
4.	53	3	4	1	5.	88	21	44	34

	T.	hhd.	gal.	qt.	pt.		sig.	deg.	mi.	sec.		A.	R.	P.
6.	29	2	47	3	1	7.	2	22	15	41	8.	408	2	22

## Promiscuous Questions in Compound Addition and Subtraction.

Quest.	No.	yds.	qr.	na.		£.	s.	d.
	1.	36	3	2	2.	1st.	6	2 4
	"	2,	45	1 3		2d.	5 10	9½
	"	3,	48	2 1		3d.	7 0	0
	"	4,	52	0 3		4th.	8 10	6
	"	5,	64	2 0		5th.	9 2	6
<hr/>						<hr/>		
		yards	247	2 1		£36	6	1½ cost
					Received	£22	10	6
<hr/>						<hr/>		
					Note	£13	15	7½

Page 32.

	<i>lb. oz. dwt. gr.</i>		<i>lb. oz. dr. sc. gr.</i>
Quest. 3. Bought	26 9 10 0	4. Bought	6 10 6 2 0
Wrought up	18 0 16 10	Used	4 5 4 1 17
Has left	8 8 13 14		lb. 2 5 2 0 3

	<i>yrs. mo. day. hr.</i>	
5. Charles born	1817 3 20 9 evening	
William born	1816 1 15 6 morning	

Year 1 2 5 15

	<i>Cwt. qr. lb.</i>
6. 1st.	18 2 14
2d.	16 3 18
3d.	22 0 24
4th.	24 1 0

Cwt. 82 0 0

Or, 4 Ton, 2 cwt.

	<i>yds.</i>
7. sold to A	5½
B	6¼
C	7¾
	20½

yds. 40 sold and left.

*yds.*  
Then from 55  
take 40

yds. 15 for D and E.

But because E has half as much as D, and together have 15; therefore D has 10, and E has 5.

	<i>gals.</i>
8. bought 1 pipe	= 126
2 hhd.	= 126
3 quarter casks	{ 26
	{ 26
	{ 26

330 bought  
148½ sold and leaked

181½ left.

	<i>gals.</i>
sold 1 hhd.	63
2 qr. casks	52
leaked { pipe	17
	{ hhd. 11
	{ cask 5½

gallons 148½

9. Bought *E. Fr. qr. na. yds. qr. na.*

two first	{ 9	3	2=14	1	2
	{ 9	3	2=14	1	2
two last	{ 8	2	3=12	2	3
	{ 8	2	3=12	2	3

yards 54 0 2  
40 2 0

13 2 2 yards left.

## COMPOUND MULTIPLICATION.

Case 1. Page 33.

2.	<i>T. cwt. qr. lb. oz. dr.</i>	146	2	3	44	6	1	3.	<i>lb. oz. dwt. gr.</i>	71	10	17	7			
4.	<i>bu. pc. qt.</i>	199	3	0	5.	<i>hhd. gal. qt. pt.</i>	283	33	2	1	6.	<i>deg. mi. fur. p.</i>	67	18	6	32
7.	<i>yds. ft. in. bc.</i>	149	1	4	0	8.	<i>A. R. P.</i>	809	0	34	9.	<i>bu. pc. qt.</i>	538	1	2	
10.	<i>d. h. mi. sec.</i>	763	8	44	15	11.	<i>yrs. m. w. d.</i>	1508	2	2	6					

*Application.*

Quest. 1.	<i>£. s. d.</i>	2	6	4	5	2.	<i>£. s. d.</i>	1	2	8 $\frac{1}{4}$	9
		£11	11	8				£10	2	6 $\frac{1}{4}$	
3.	<i>£. s. d.</i>	0	12	9 $\frac{1}{2}$	11	4.	<i>£. s. d.</i>	2	4	2 $\frac{1}{2}$	12
		£7	0	8 $\frac{1}{2}$				£26	10	6	

Case 2. Page 34.

*Application.*

1.	<i>T. cwt. qr. lb. oz. dr.</i>	4	3	1	16	8	10 by 36	6
		25	0	1	15	3	12 product by 6	6
		150	2	1	7	6	8 product by 36	
2.	<i>£. s. d.</i>	Mult. 120	6	9	by 24	6		
		722	0	6	product by 6	4		
		2888	2	0	product by 24			
3.	<i>T. cwt. qr. lb.</i>	Mult. 24	4	2	7 by 48	12		
		290	14	3	0 pro. by 12	4		
		1162	19	0	0 pro. by 48			

*d. h. mi. sec.*

4

7

8 4 12 5 " 1

Case 4. Page 35.

10

10

2

29 0 0 " of 40

£.   s.   d.

10

10

2

5 12 6 ' of 5

2\*

10

10

11 2 6 ' ' 10

7 15 9 ' ' 7

£130 3 3 val. of 117

## COMPOUND DIVISION.

Case 1. Page 36.

2. Ans.  $\begin{array}{r} \text{£.} \\ 187 \\ \text{s.} \\ 18 \\ \text{d.} \\ 5\frac{1}{2} \end{array}$       3. Ans.  $\begin{array}{r} T. \text{ cwt.} \\ 15 \\ \text{qr.} \\ 6 \\ \text{lb.} \\ 0 \ 7 \end{array}$
4. Ans.  $\begin{array}{r} \text{yds.} \\ 192 \\ \text{ft.} \\ 0 \\ \text{in.} \\ 4\frac{1}{5} \end{array}$       5. Ans.  $\begin{array}{r} T. \text{ hhd.} \\ 58 \\ \text{gal.} \\ 2 \ 13 \\ \text{qt.} \\ 3\frac{7}{8} \end{array}$
6. Ans.  $\begin{array}{r} \text{w.} \\ 3 \\ \text{d.} \\ 0 \\ \text{h.} \\ 16 \\ \text{mi.} \\ 16 \\ \text{sec.} \\ 53 \end{array}$

Case 2.

2.  $\begin{array}{r} \text{£.} \\ 11 \overline{)134} \\ \text{s.} \\ 18 \\ \text{d.} \\ 8 \end{array}$       3.  $\begin{array}{r} \text{£.} \\ 12 \overline{)984} \\ \text{s.} \\ 0 \\ \text{d.} \\ 0 \end{array}$
- 4)  $\begin{array}{r} 12 \\ 5 \\ 4 \end{array}$  quot. by 11      12)  $\begin{array}{r} 82 \\ 0 \\ 0 \end{array}$  by 12
- $\begin{array}{r} \text{£}3 \\ 1 \\ 4 \end{array}$  ' by 44       $\begin{array}{r} \text{£}6 \\ 16 \\ 8 \end{array}$  by 144
4.  $\begin{array}{r} \text{£.} \\ 12 \overline{)474} \\ \text{s.} \\ 0 \\ \text{d.} \\ 0 \end{array}$
- 6)  $\begin{array}{r} 39 \\ 10 \\ 0 \end{array}$  quotient by 1
- $\begin{array}{r} \text{£}6 \\ 11 \\ 8 \end{array}$  ' by 7

Case 3. Page 37.

2.  $\begin{array}{r} \text{£.} \\ 345 \overline{)409} \\ \text{s.} \\ 13 \\ \text{d.} \\ 9 \end{array}$  (  $\begin{array}{r} \text{£.} \\ 1 \\ \text{s.} \\ 3 \\ \text{d.} \\ 9 \end{array}$
- $\begin{array}{r} 345 \\ \hline 64 \\ 20 \\ \hline 345 \overline{)1293} (3s. \\ 1035 \\ \hline 258 \\ 12 \\ \hline 345 \overline{)3105} (9d. \\ 3105 \end{array}$
3.  $\begin{array}{r} \text{£.} \\ 232 \\ \text{s.} \\ 4 \\ \text{d.} \\ 9 \end{array}$
- $\begin{array}{r} 20 \\ \hline 524 \overline{)4644} (8 \text{ } 10\frac{1}{4} \frac{2}{5} \frac{4}{2} \frac{8}{4} \\ 4192 \\ \hline 452 \\ 12 \\ \hline 524 \overline{)5433} (10d. \\ 524 \\ \hline 193 \\ 4 \\ \hline 524 \overline{)772} (1 \text{ qr.} \\ 524 \\ \hline 248 \text{ rem.} \end{array}$



Page 37.

$$\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \quad \text{£.} \quad \text{s.} \quad \text{d.} \\ 4. \quad 654 \overline{) 3236} \quad 12 \quad 4\frac{1}{2} \quad ( \quad 4 \quad 18 \quad 11\frac{3}{4} \\ \underline{2616} \end{array}$$

$$\begin{array}{r} 620 \\ 20 \\ \hline \end{array}$$

$$654 \overline{) 12412} (18\text{s.}$$

$$\begin{array}{r} 654 \\ \hline \end{array}$$

$$\begin{array}{r} 5872 \\ 5232 \\ \hline \end{array}$$

$$\begin{array}{r} 640 \\ 12 \\ \hline \end{array}$$

$$654 \overline{) 7684} (11\text{d.}$$

$$\begin{array}{r} 654 \\ \hline \end{array}$$

$$\begin{array}{r} 1144 \\ 654 \\ \hline \end{array}$$

$$\begin{array}{r} 490 \\ 4 \\ \hline \end{array}$$

$$654 \overline{) 1962} (3\text{qr.}$$

$$\begin{array}{r} 1962 \\ \hline \end{array}$$

$$\begin{array}{r} \text{£.} \quad \text{s.} \quad \text{d.} \quad \text{£.} \quad \text{s.} \quad \text{d.} \\ 5. \quad 68 \overline{) 132} \quad 0 \quad 8 \quad ( \quad 1 \quad 18 \quad 10 \\ \underline{68} \end{array}$$

$$\begin{array}{r} 64 \\ 20 \\ \hline \end{array}$$

$$68 \overline{) 1280} (18\text{s.}$$

$$\begin{array}{r} 68 \\ \hline \end{array}$$

$$\begin{array}{r} 600 \\ 544 \\ \hline \end{array}$$

$$\begin{array}{r} 56 \\ 12 \\ \hline \end{array}$$

$$68 \overline{) 680} (10\text{d.}$$

$$\begin{array}{r} 68 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \\ \hline \end{array}$$

*Promiscuous Questions for Exercise in Compound Addition, Subtraction, Multiplication and Division.*

$$\begin{array}{r} \text{Quest. 1.} \quad \text{s.} \quad \text{d.} \\ 2 \quad 5 \times 2 \\ \underline{10} \end{array}$$

$$\begin{array}{r} 1 \quad 4 \quad 2 \times 7 \\ \underline{10} \end{array}$$

$$\begin{array}{r} 12 \quad 1 \quad 8 \\ \underline{6} \end{array}$$

$$\begin{array}{r} 72 \quad 10 \quad 0 \text{ value of 600 yards} \\ 8 \quad 9 \quad 2 \quad \text{' of 70 ' } \\ 4 \quad 10 \quad \text{' of 2 ' } \end{array}$$

$$\begin{array}{r} \text{£} 81 \quad 4 \quad 0 \text{ value of 672 yards} \end{array}$$

$$\begin{array}{r} T. \text{ cwt.} \quad \text{qr.} \quad \text{lb.} \\ 3. \quad 1 \quad 2 \quad 3 \quad 16 \\ \text{Mult. by} \quad \quad \quad 8 \text{ loads} \\ \hline 9 \quad 3 \quad 0 \quad 16 \end{array}$$

$$\begin{array}{r} \text{lb.} \quad \text{oz.} \quad \text{dwt.} \quad \text{gr.} \\ 2. \quad 4 \quad 1 \quad 15 \quad 22 \\ \hline 11 \text{ ingots} \end{array}$$

$$\begin{array}{r} 45 \quad 7 \quad 15 \quad 2 \end{array}$$

$$\begin{array}{r} T. \text{ cwt.} \quad \text{qr.} \quad \text{lb.} \\ 4. \quad 8 \quad ) \quad 9 \quad 3 \quad 0 \quad 16 \\ \hline 1 \quad 2 \quad 3 \quad 16 \text{ one share} \end{array}$$

Page 37.

	<i>A.</i>	<i>R.</i>	<i>P.</i>
5.	300	2	20
			5

1503 0 20  
3

4509 1 20

Page 38.

	<i>A.</i>	<i>R.</i>	<i>P.</i>
6. 5)	4509	1	20
	3)901	3	20
	300	2	20

	<i>bu.</i>	<i>d.</i>	<i>c.</i>	<i>d.</i>	<i>c.</i>	<i>m.</i>
7.	179 )	201	37½	( 1	12	5
		179		or 1	doll.	12½c.

223179447358895895

8.  $\begin{array}{r} d. \\ 7 \times 5 \\ 10 \end{array}$

$$\frac{5}{10} \times \frac{10}{6}$$

2 18 4  
3

8 15 0 in 300 days  
1 15 0 ' 60 '  
2 11 ' 5 '

£10 12 11 in 365 days

	<i>bu.</i>	<i>d.</i>	<i>c.</i>	<i>d.</i>	<i>c.</i>		11.	£.	<i>s.</i>	<i>d.</i>
10.	135	×	2	05	=	276 75		3)	47	12 10½
	135	×	1	62½	=	219 37½		9)	15	17 7½
						\$57 37½		£1	15	3½
						gain				

Page 38.

<p>12. <i>dolls.</i> 9708 2</p> <hr/> <p>5)19416</p> <hr/> <p>3883 20 eldest son.</p> <hr/> <p>3)5824 80 rem.</p> <hr/> <p>\$ 1941 60 other sons, each</p>	<p>13. <i>dwt. gr.</i> 17 8 9</p> <hr/> <p>7 16 0 wt. of 9 dolls.</p> <hr/> <p>5</p> <hr/> <p>oz. 39 0 0 wt. of 45 dolls.</p>
--	---

<p>14. <i>oz. dwt. gr.</i> 84 7 20 20</p> <hr/> <p><i>dwt. gr. gr.</i> 150)1687 ( 11 6 + 8 over 150 11 6 standard</p> <hr/> <p>187 0 0 + 8 grains over 150</p> <hr/> <p>37 24</p> <hr/> <p>148 76</p> <hr/> <p>150)908(6 900</p> <hr/> <p>8 grains</p>	<p>15. <i>cwt. lb.</i> 2½ = 280</p> <p>Mult. by 133 mills</p> <hr/> <p>\$37,24</p>
--	--

16. 35 × 20 dolls. notes = 700 dolls.  
 63 Eagles = 630  
 284 dollars = 284  
 642 half dollars = 321  
 368 qr. dollars = 92  
 256 × 12½ cents = 32

Deposited Dolls.	2059
Checks 560 + 820 =	1380
	<hr/>
Dolls.	679

Page 38.

$$\begin{array}{rcl}
 & \text{dolls.} & \text{cts.} \quad \text{dolls.} \quad \text{cts.} \\
 17. & 36 \text{ yds. at } 4 & 66 = 167,76 \text{ cost} \\
 & & \text{Add } 29,56 \text{ gained} \\
 & & \hline
 \end{array}$$

Must sell all for \$197,32

$$\begin{array}{rcl}
 & \text{dolls.} & \text{cts.} \quad \text{d.} \quad \text{c.} \\
 & 4 \text{ yds. at } 2 & 33 = 9,32 \\
 & 8 \text{ yds. at } 5 & 50 = 44,00 \\
 & \hline
 \end{array}$$

12 yds. is sold for \$53,32

$$\begin{array}{rcl}
 & & \text{dolls.} \quad \text{cts.} \\
 \text{Now, from } 36 \text{ yds. which must sell for} & 197 & 32 \\
 \text{Take } 12 \text{ yds. which brought } & 53 & 32 \\
 & \hline
 \end{array}$$

The diff. 24 yds. must sell for \$144 00

*yds. dolls.*  
 But 24) 144 (6 dollars.

$$\begin{array}{rcl}
 & \text{cts.} & \text{d.} \quad \text{cts.} \\
 18. & 12\frac{1}{2} \times 5 = 0 & 62\frac{1}{2} \text{ beds} \\
 & 6\frac{1}{2} \times 4 = 2 & 50 \text{ supper and breakfast} \\
 & & 75 \text{ for liquor} \\
 & 25 \times 5 = 1 & 25 \text{ for hay} \\
 & \hline
 \end{array}$$

\$5 12 $\frac{1}{2}$ 

From 6 dollars take \$5,12 $\frac{1}{2}$ , and the remainder  
 is 87 $\frac{1}{2}$  cts. = 875 mills.

*cts. ms.*

But 2 $\frac{1}{2}$  = 25) 875 (35 qts. = 8 $\frac{3}{4}$  galls.  
 And 6 dollars  $\div$  5 travelers = \$1,20 = 120 cts.

Page 39.

$$\begin{array}{rcl}
 & \text{h.} & \text{m.} & \text{h.} & \text{m.} & \text{minutes} \\
 19. & 12 & 25 \times \text{by } 5 = & 62 & 5 = & 3725 \\
 & 11 & 30 \times \text{by } 9 = & 103 & 30 = & 6210 \\
 & & & \hline
 \end{array}$$

Sum 9935 minutes

Now 9935 minutes

Mult. by 75 cents per day

49675

69545

$$\begin{array}{rcl}
 & \text{h.} & \text{m.} & \text{dolls.} & \text{cts.} & \text{ms.} \\
 8 = 480 & ) & 745125 & ( & 15 & 52 & 3+
 \end{array}$$

Page 39.

$$\begin{array}{r}
 \text{gal. qt. pt.} \\
 20. \quad 5 \overline{)1534} \quad 1 \quad 1 \\
 \hline
 \quad \quad 5 \overline{)306} \quad 3 \quad 1 \\
 \hline
 \end{array}$$

galls. 61 1 1

$$\begin{array}{r}
 22. \quad A \quad 1 \\
 \quad \quad B \quad 2 \\
 \quad \quad C \quad 6 \\
 \quad \quad - \\
 \quad \quad 9
 \end{array}$$

$$\begin{array}{r}
 h. \quad mi. \\
 21. \quad 9 \overline{)114} \quad 45 \\
 \hline
 12h \quad 45min.
 \end{array}$$

$$\begin{array}{r}
 \text{dolls.} \\
 9 \overline{)180} \\
 \hline
 20 \quad A's \text{ share} \\
 20 \times 2 = 40 \quad B's \\
 40 \times 3 = 120 \quad C's
 \end{array}$$

## REDUCTION.

MONEY. Page 41.

$$4. \quad 4 \overline{)120506} \text{ farthings}$$

$$12 \overline{)30126} \frac{1}{2}$$

$$2 \overline{)0} \quad 251 \overline{)0} \quad 6 \frac{1}{2}$$

$$\pounds 125 \quad 10 \quad 6 \frac{1}{2}$$

$$\begin{array}{r}
 5. \quad 10 \overline{)260} \text{ cents} \\
 \quad \quad 26 \text{ subtract} \\
 \hline
 \quad \quad 234 \text{ pence}
 \end{array}$$

Page 42.

$$\begin{array}{r}
 \pounds. \quad s. \quad d. \\
 6. \quad 480 \quad 19 \quad 9 \\
 \quad \quad 20 \\
 \hline
 \quad \quad 9619 \\
 \quad \quad 12 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 9 \overline{)115437} \text{ pence} \\
 \quad \quad 12826 \frac{1}{3} \text{ add} \\
 \hline
 128263 \frac{1}{3} \text{ cents}
 \end{array}$$

$$7. \quad 12 \overline{)4658}$$

$$2 \overline{)0} \quad 38 \overline{)8} \quad 2$$

$$\pounds 19 \quad 8 \quad 2$$

$$\begin{array}{r}
 8. \quad 9 \overline{)648} \text{ pence} \\
 \quad \quad 72 \text{ add} \\
 \hline
 \quad \quad 720 \text{ cents}
 \end{array}$$

$$\begin{array}{r}
 9. \quad 720 \text{ cents} \\
 \quad \quad \frac{1}{10} = 72 \text{ subtract} \\
 \hline
 \quad \quad 648 \text{ pence}
 \end{array}$$

$$\begin{array}{r}
 10. \quad 2 \overline{)24235} \text{ half pence} \\
 \quad \quad 12 \overline{)12117} \frac{1}{2} \\
 \hline
 \quad \quad 2 \overline{)0} \quad 100 \overline{)9} \quad 9 \frac{1}{2} \\
 \hline
 \quad \quad 1. \quad 50 \quad 9 \quad 9 \frac{1}{2}
 \end{array}$$

11. 216 French crowns  
Mult. 99 pence in a crown

1944

1944

12)21384 pence

2|0) 178|2

89l. 2s.

13. 375l.  
8

3)3000

\$1000

12. £. s.  
29 17

20

597

12

7164

$\frac{1}{9} = 796$  add

7960 cents

Or, 79 dolls. 60 cents.

### TROY WEIGHT.

1. 24 { 4)115200 grains  
6)28800  
2|0) 480|0 pennyweights  
12)240 ounces  
lb. 20

2. 30 pounds  
12  
360 oz.  
20  
7200 dwts.  
24  
172800 gr.

3. 2|0)4564|8 dwts.  
2282 oz. 8 dwt.

4. lb. oz. dwt. gr.  
4 8 15 20  
12

56 ounces

20

1135 dwts.

24

4540

2272

5. 24 { 4)27260 grains  
6) 6815  
2|0)113|5 20  
12) 56 15 20

4lb. 8oz. 15dwt. 20gr.

27260 grains.

Page 42.

	<i>dwt.</i>	<i>gr.</i>
6.	8	6
	24	
	<hr/>	
	198	gr.
	24	spoons
	<hr/>	
	792	
	396	
	<hr/>	
	4752	grains

## AVOIRDUPOIS WEIGHT.

1.	3 tons
	20
	<hr/>
	60 cwt.
	4
	<hr/>
	240 qr.
	28
	<hr/>
	1920
	480
	<hr/>
	6720 lb.

2.	16	{	4) 2867200	drams
			<hr/>	
			4) 716800	
			<hr/>	
	16	{	4) 179200	oz.
			<hr/>	
			4) 44800	
			<hr/>	
			28) 11200	lb.
			<hr/>	
			4) 400	qr.
			<hr/>	
			2 0) 10 0	cwt.
			<hr/>	
				5 tons.

3.	<i>Tons.</i>
	5
	20
	<hr/>
	100
	4
	<hr/>
	400 gr.
	28
	<hr/>
	11200 lb.
	16
	<hr/>
	179200 oz.
	16
	<hr/>
	2867200 dr.

4.	<i>cwt. gr.</i>
	1 3
	4
	<hr/>
	7
	28
	<hr/>
	196 lbs.
	Mult. 6 barrels
	<hr/>
	1176 lbs.

Page 42.

$$\begin{array}{r}
 \text{cwt.} \quad \text{qr.} \quad \text{lb.} \\
 5. \quad 16 \quad 2 \quad 14 \\
 \quad \quad 4 \\
 \quad \quad \text{---} \\
 \quad \quad 66 \\
 \quad \quad 28 \\
 \quad \quad \text{---} \\
 \quad \quad 532 \\
 133 \quad . \\
 \quad \quad \text{---} \\
 1862 \text{ lb.}
 \end{array}$$

$$\begin{array}{r}
 \text{lb.} \\
 6. \quad 28 \overline{)2876} \\
 \quad \quad \text{---} \\
 \quad \quad 4 \overline{)10220} \\
 \quad \quad \quad \text{---} \\
 \quad \quad \quad 25 \text{ cwt. } 2 \text{ qr. } 20 \text{ lb.}
 \end{array}$$

## APOTHECARIES' WEIGHT.

$$\begin{array}{r}
 \text{lb.} \\
 1. \quad 15 \\
 \quad \quad 12 \\
 \quad \quad \text{---} \\
 \quad \quad 180 \text{ oz.} \\
 \quad \quad \quad 8 \\
 \quad \quad \quad \text{---} \\
 \quad \quad 1440 \text{ dr.} \\
 \quad \quad \quad 3 \\
 \quad \quad \quad \text{---} \\
 \quad \quad 4320 \text{ scr.}
 \end{array}$$

Page 43.

$$\begin{array}{r}
 \text{lb.} \\
 2. \quad 3 \\
 \quad \quad 12 \\
 \quad \quad \text{---} \\
 \quad \quad 36 \text{ oz.} \\
 \quad \quad \quad 8 \\
 \quad \quad \quad \text{---} \\
 \quad \quad 288 \text{ dr.} \\
 \quad \quad \quad 3 \\
 \quad \quad \quad \text{---} \\
 \quad \quad 864 \text{ sc.} \\
 \quad \quad \quad 20 \\
 \quad \quad \quad \text{---} \\
 17280 \text{ gr.}
 \end{array}$$

$$\begin{array}{r}
 \text{lb.} \\
 3. \quad 2\frac{1}{2} \\
 \quad \quad 12 \\
 \quad \quad \text{---} \\
 \quad \quad 30 \\
 \quad \quad \quad 8 \\
 \quad \quad \quad \text{---} \\
 16 \overline{)240} \text{ drams} \\
 \quad \quad \text{---} \\
 \quad \quad 15 \text{ parcels}
 \end{array}$$

$$\begin{array}{r}
 4. \quad 2 \overline{)0} 57600 \overline{)0} \text{ grains} \\
 \quad \quad \quad \text{---} \\
 \quad \quad \quad 3 \overline{)28800} \text{ sc.} \\
 \quad \quad \quad \quad \text{---} \\
 \quad \quad \quad 8 \overline{)9600} \text{ dr.} \\
 \quad \quad \quad \quad \quad \text{---} \\
 \quad \quad \quad 12 \overline{)1200} \text{ oz.} \\
 \quad \quad \quad \quad \quad \quad \text{---} \\
 \quad \quad \quad \quad \quad 100 \text{ lb.}
 \end{array}$$



## CLOTH MEASURE. Page 43.

$$\begin{array}{r}
 1. \quad 250 \text{ yards} \\
 \quad \quad 4 \\
 \hline
 1000 \text{ qrs.} \\
 \quad \quad 4 \\
 \hline
 4000 \text{ nails.}
 \end{array}$$

$$\begin{array}{r}
 2. \quad 4)8642 \text{ nails} \\
 \hline
 5)2160 \text{ 2 nails} \\
 \hline
 432 \text{ Ells E. 2 na.}
 \end{array}$$

$$\begin{array}{r}
 3. \quad 324 \text{ Ells Fr.} \\
 \quad \quad 6 \\
 \hline
 4)1944 \text{ qrs.} \\
 \hline
 486 \text{ yards}
 \end{array}$$

$$\begin{array}{r}
 4. \quad 16 \text{ bales} \\
 \quad \quad 36 \text{ E. Fl.} \\
 \hline
 96 \\
 48 \\
 \hline
 576 \text{ E. Fl.} \\
 \quad \quad 3 \\
 \hline
 4)1728 \text{ qrs.} \\
 \hline
 432 \text{ yards.}
 \end{array}$$

## LONG MEASURE

$$\begin{array}{r}
 1. \quad 260 \text{ miles} \\
 \quad \quad 8 \\
 \hline
 2080 \\
 \quad \quad 40 \\
 \hline
 83200 \\
 \quad \quad 5\frac{1}{2} \\
 \hline
 416000 \\
 41600 \\
 \hline
 457600 \text{ yds.} \\
 \quad \quad 3 \\
 \hline
 1372800 \text{ feet} \\
 \quad \quad 12 \\
 \hline
 16473600 \text{ inches}
 \end{array}$$

$$\begin{array}{r}
 2. \quad \begin{array}{cccc} \text{mi.} & \text{fu.} & \text{P.} & \text{yds. ft.} \end{array} \\
 \quad \quad 11 \quad 7 \quad 38 \quad 2 \quad 2 \\
 \quad \quad 8 \\
 \hline
 95 \\
 40 \\
 \hline
 3838 \\
 \quad \quad 5\frac{1}{2} \\
 \hline
 19192 \\
 1919 \\
 \hline
 21111 \\
 \quad \quad 3 \\
 \hline
 63335 \\
 \quad \quad 12 \\
 \hline
 760020 \\
 \quad \quad 3 \\
 \hline
 2280060 \text{ b. c.}
 \end{array}$$

Page 43.

3.      3)1267200 feet

220) 422400 yards

8) 1920 furlongs

60) 240 miles

4 degrees

4.      *L. fu. yds. ft. in.*  
          3   2   110   1   5  
          3 miles  
          —  
          9  
          3 fur.  
          —  
          74  
          220 yds.  
          —  
          1490  
          149  
          —  
          16390  
          3  
          —  
          49171  
          12  
          —  
          590057 inches

5.      360 degrees round  
          60 miles

21600

8 furlongs

172800

220 yards

38016000

3 feet

114048000

12 inches

1368576000

## LAND MEASURE.

1.      25 acres

4

100

40

4000 perches

2.      4)0)17600|0 perches

4) 4400 roods

1100 acres

Page 43.

$$\begin{array}{r}
 3. \quad 4 \overline{)00} 6400 \overline{)00} \text{ perches} \\
 \quad 4 \overline{)0} 160 \overline{)0} \text{ each share} \\
 \quad 4 \overline{)0} 40 \text{ roods} \\
 \quad \quad 10 \text{ acres}
 \end{array}$$

$$\begin{array}{r}
 4. \quad 10 \text{ acres} \\
 \quad 160 \\
 \quad \quad 1600 \text{ perches} \\
 \quad \quad 30 \frac{1}{4} \\
 \quad \quad 48000 \\
 \quad \quad 400 \\
 \quad \quad 48400 \text{ yards} \\
 \quad \quad 9 \\
 \quad \quad 435600 \text{ feet} \\
 \quad \quad 144 \\
 \quad \quad 62726400 \text{ inches}
 \end{array}$$

## CUBIC, OR SOLID MEASURE.

$$1. \quad \begin{array}{c} \text{ft.} \quad \text{feet.} \\ 128 \overline{) 3200} \end{array} (25 \text{ cords})$$

Page 44.

$$2. \quad \begin{array}{c} \text{ton.} \quad \text{ft.} \quad \text{feet.} \\ 20 \times 50 = 1000 \end{array}$$

$$3. \quad \begin{array}{c} \text{ton.} \quad \text{ft.} \quad \text{cu. in.} \quad \text{cu. in.} \\ 30 \times 40 \times 1728 = 2073600 \end{array}$$

TIME. Page 45.

$$\begin{array}{r}
 1. \quad \begin{array}{c} \text{w.} \quad \text{d.} \quad \text{h.} \quad \text{m.} \\ 3 \quad 2 \quad 6 \quad 20 \\ \hline 7 \\ \hline 58 \\ 24 \\ \hline 238 \\ 116 \\ \hline 1398 \\ 60 \\ \hline 83900 \text{ min.} \end{array}
 \end{array}$$

$$\begin{array}{r}
 2. \quad \begin{array}{c} \text{da.} \quad \text{h.} \\ 365 \quad 6 \text{ in one year} \\ \hline 24 \\ \hline 1466 \\ 730 \\ \hline 8766 \\ 60 \\ \hline 525960 \\ 60 \\ \hline 31557600 \text{ sec.} \\ 10 \text{ years} \\ \hline 315576000 \end{array}
 \end{array}$$

$$3. \quad \begin{array}{c} \text{yrs.} \quad \text{days} \quad \text{days} \quad \text{hrs.} \\ 1823 \times 365 \frac{1}{4} = 665850 \quad 18 \end{array}$$

$$4. \quad \begin{array}{c} \text{w. da. hr. mi. sec.} \\ 1 \times 7 \times 24 \times 60 \times 60 = 604800 \text{ sec.} \end{array}$$

## LIQUID MEASURE. Page 45.

$$\begin{array}{r}
 1. \quad 4 \text{ tuns} \\
 \quad 4 \\
 \hline
 \quad 16 \text{ hhds.} \\
 \quad 63 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 1008 \text{ galls.} \\
 8 \\
 \hline
 \end{array}$$

$$8064 \text{ pints}$$

$$\begin{array}{r}
 2. \quad \begin{array}{l} \text{pints.} \\ 8 \end{array} ) 4032 \\
 \hline
 63 ) 504 \text{ galls.} \\
 \hline
 \quad 8 \text{ hhds.}
 \end{array}$$

$$3. \quad \begin{array}{l} \text{hhd. gal. pt.} \\ 38 \times 63 \times 8 = 19152 \text{ pints.} \end{array}$$

## DRY MEASURE.

$$1. \quad \begin{array}{l} 73 \text{ bu. } 3 \text{ pc. } 7 \text{ qt.} \\ 4 \end{array}$$

$$\begin{array}{r}
 315 \\
 8 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 2527 \\
 2 \\
 \hline
 \end{array}$$

$$5054 \text{ pints}$$

$$2. \quad 2 ) 2196$$

$$8 ) 1098$$

$$4 ) 1372$$

$$34 \text{ bu. } 1 \text{ pc. } 2 \text{ qt.}$$

## ADDITION OF DECIMALS.

Page 47.

$$2. \quad \text{Ans. } 3923400,3687078$$

$$\begin{array}{r}
 3. \quad \begin{array}{r} 283,604 \\ 490006,003275 \\ 21,05 \\ 1,2 \\ 6200,3476 \end{array} \\
 \hline
 \end{array}$$

$$\text{Sum } 496512,204875$$

$$\begin{array}{r}
 4. \quad \begin{array}{r} ,246 \\ ,012 \\ ,02 \\ ,6 \\ ,413 \\ ,5 \end{array} \\
 \hline
 \end{array}$$

$$\text{Sum } 1,791$$

$$\begin{array}{r}
 5. \quad \begin{array}{r} 26,52 \\ 225,005 \\ ,0035 \\ 844, \\ 2,2 \\ 300,825 \\ ,00005 \end{array} \\
 \hline
 \end{array}$$

$$\text{Sum } 1297,55355$$

$$\begin{array}{r}
 6. \quad \begin{array}{r} 125,5 \\ 10000,000005 \\ 15,072 \\ 2,01 \end{array} \\
 \hline
 \text{Sum } 10142,582005
 \end{array}$$

$$\begin{array}{r}
 7. \quad \begin{array}{r} 5,4 \\ 15,04 \\ 100,004 \\ 6000,00004 \\ 93880,0004 \end{array} \\
 \hline
 \text{Sum } 100000,44444
 \end{array}$$

## SUBTRACTION OF DECIMALS.

Page 47.

$$2. \quad \text{Ans. } 685,495632$$

$$4. \quad \begin{array}{r} \text{From } 45,005 \\ \text{Take } 23,65482 \\ \hline \text{Diff. } 21,35018 \end{array}$$

$$3. \quad \text{Ans. } 8,3047$$

$$5. \quad \begin{array}{r} \text{From } 620,2 \\ \text{Take } 200,002 \\ \hline \text{Diff. } 420,198 \end{array}$$

Page 48.

$$6. \quad \begin{array}{r} \text{From } 5, \\ \text{Take } ,10438 \\ \hline 4,89562 \end{array}$$

$$7. \quad \begin{array}{r} \text{From } 2, \\ \text{Take } ,00002 \\ \hline 1,99998 \end{array}$$

$$8. \quad \begin{array}{r} \text{From } 16, \\ \text{Take } ,016 \\ \hline 15,984 \end{array}$$

## MULTIPLICATION OF DECIMALS.

$$4. \quad \begin{array}{r} \text{Mult. } ,385746 \\ \text{by } ,00463 \\ \hline 1157238 \\ 2314476 \\ 1542984 \\ \hline ,00178600398 \end{array}$$

$$5. \quad \begin{array}{r} \text{Mult. } 158,694 \\ \text{by } 23,15 \\ \hline 793470 \\ 158694 \\ 476082 \\ 317388 \\ \hline 3673,76610 \end{array}$$

$$6. \quad \begin{array}{r} \text{Mult. } ,024653 \\ ,00022 \\ \hline 49306 \\ 49306 \\ \hline ,00000542366 \end{array}$$

$$7. \quad \begin{array}{r} \text{Mult. } 25,04 \\ ,002 \\ \hline ,05003 \end{array}$$

$$8. \quad \begin{array}{r} \text{Mult. } 645,003 \\ ,000005 \\ \hline ,003225015 \end{array}$$

*Contraction in Multiplication of Decimals.*

Page 50.

$$3. \quad \begin{array}{r} 23,463 \text{ multiplicand} \\ 43,2 \text{ multiplier reversed} \\ \hline 46926 \\ 7039 \\ 933 \\ \hline 54,903 \end{array}$$

$$5. \quad \begin{array}{r} 3,141592 \text{ multiplicand} \\ 3347,25 \text{ mult. rev.} \\ \hline 1570796 \\ 62932 \\ 21991 \\ 1257 \\ 94 \\ 25 \\ \hline 165,6995 \end{array}$$

$$4. \quad \begin{array}{r} 234,216 \text{ multiplic.} \\ 543,2 \text{ mult. rev.} \\ \hline 46843 \\ 7026 \\ 937 \\ 117 \\ \hline 549,23 \end{array}$$

## DIVISION OF DECIMALS.

Page 50.

3.  $23,7)65321,0(2756,16$

474

1792

1659

1331

1185

1460

1422

380

237

1430

1422

8 rem.

4.  $64,25)234,70525(3,653$

19275

41955

38550

34052

32125

19275

19275

5.  $3)10,$

3,3333 $\frac{1}{3}$ 

6.  $,9)9,0$

10

7.  $,00463),00178600398(,385746$

1389

3970

3704

2660

2315

3453

3241

2129

1852

2778

2778

Page 51.

3.  $2,46),2327898(,09463$

2214

1138

984

1549

1476

738

738

9.  $,09463),2327898(2,46$

18926

43529

37852

56778

56778

Page 51.

$$10. \quad ,018),000162(,009 \\ 162$$

*Contraction in Division of Decimals.*

Page 52.

$4. \quad 1,346787)74,33373(55,193$	$5. \quad 9,365407)87,076326(9,297$
$\begin{array}{r} 67339 \\ \hline 6994 \\ 6734 \\ \hline 260 \\ 135 \\ \hline 125 \\ 121 \\ \hline 4 \\ 4 \end{array}$	$\begin{array}{r} 84289 \\ \hline 2787 \\ 1873 \\ \hline 914 \\ 843 \\ \hline 71 \\ 65 \\ \hline 6 \end{array}$

$$6. \quad 2,45)32,68744231(13,34$$

$$\begin{array}{r} 245 \\ \hline 818 \\ 735 \\ \hline 83 \\ 73 \\ \hline 10 \\ 10 \end{array}$$

$$7. \quad 6,24),0046872345(,00075$$

$$\begin{array}{r} 437 \\ \hline 31 \\ 31 \\ \hline 0 \end{array}$$

**REDUCTION OF DECIMALS.**

Case 1. Page 53.

$$2. \quad 2)1,0(,5$$

$$3. \quad 4)3,00(,75$$

Page 53.

4.  $8)7,000(.875$

5.  $25)1,00(.04$

6.  $60)57,00(.95$

7.  $15)6,00(.40 \text{ cents}$

Case 2.

2.  $\begin{array}{r} s. \\ 19 \div 20 = .95 \end{array}$

3.  $\begin{array}{r} d. \\ 3 \div 12 = .25 \end{array}$

4.  $\begin{array}{r} d. \\ 3 \div (12 \times 20) = .0125 \end{array}$

5.  $\begin{array}{r} \text{cwt. qr. qr.} \\ 4 \ 2 = 18 \div (20 \times 4) = .225 \text{ ton} \end{array}$

6.  $\begin{array}{r} \text{qr. lb. lb.} \\ 2 \ 14 = 70 \div (28 \times 4) = .625 \text{ cwt.} \end{array}$

7.  $\begin{array}{r} \text{qr. na. na.} \\ 3 \ 3 = 15 \div (4 \times 4) = .9375 \text{ yds.} \end{array}$

Or thus,

5.  $\begin{array}{r|l} \text{qr.} & 4 \\ \text{cwt} & 20 \end{array} \begin{array}{l} 2, \\ 4,5 \end{array}$

6.  $\begin{array}{r|l} \text{lb.} & 28 \\ & 4 \end{array} \begin{array}{l} 14 \\ 2,5 \end{array}$

7.  $\begin{array}{r|l} \text{na.} & 4 \\ \text{qr.} & 4 \end{array} \begin{array}{l} 3 \\ 3,75 \end{array}$

,225 ton.

cwt. ,625

yds. ,9375

Case 3. Page 54.

2.  $\begin{array}{r} \text{£.} \\ ,75 \\ 20 \end{array}$

3.  $\begin{array}{r} \text{lb.} \\ ,7 \\ 12 \end{array}$

$\begin{array}{r} \text{shillings} \\ 15,00 \\ \hline 15 \text{ s.} \end{array}$

$\begin{array}{r} \text{ounces} \\ 8,4 \\ 20 \end{array}$

dwts. 8,0 8oz. 8dwts.

4.  $\begin{array}{r} ,617 \text{ cwt.} \\ 4 \end{array}$

5.  $\begin{array}{r} ,3375 \text{ acres} \\ 4 \end{array}$

$\begin{array}{r} \text{qr.} \\ 2,468 \\ 28 \end{array}$

$\begin{array}{r} \text{rood} \\ 1,3500 \\ 40 \end{array}$

$\begin{array}{r} \text{lb.} \\ 13,104 \\ 16 \end{array}$

$\begin{array}{r} \text{per.} \\ 14,0000 \end{array}$

$\begin{array}{r} \text{oz.} \\ 1,664 \\ 16 \end{array}$

1 rood 14 per.

$\begin{array}{r} \text{dr.} \\ 10,624 \end{array}$

2 qr. 13 lb. 1 oz. 10 dr.



Page 54.

6. *tun.*  
 ,258  
 4  


---

 hhd. 1,032  
 63  


---

 gal. 2,016  


---

 1 hhd. 2 gal.

7. *days.*  
 ,761  
 24  


---

 hrs. 18,264  
 60  


---

 mi. 15,840  
 60  


---

 sec. 50,400  


---

18 hr. 15 mi. 50,4 sec.

8. *lb.*  
 ,7  
 12  


---

 oz. 8,4  
 20  


---

 dwt. 8,0

9. 365,25 days in a year  
 ,3  


---

 days 109,575  
 24  


---

 hrs. 13,800  
 60  


---

 min. 48,000  


---

8 oz. 8 dwt.

109.d. 13 h. 48 m.

10. *day hr. hours*  
 ,41  $\times 24 = 9,84$   
 ,16  


---

 hrs. 9,68  
 60  


---

 min. 40,80  
 60  


---

 sec. 48,00  


---

11. *T. cwt. qr. lb.*  
 ,17 ,19 ,17 ,7  
 20  


---

 cwt. 3,59  
 4  


---

 2,53  
 28  


---

 15,54  


---

9 h. 40 m. 48 sec.

3cwt. 2qr. 15,54lb.

*Promiscuous Questions in Decimal Fractions.*

Page 55.

Quest. 1. Mult. ,09  
by ,009

Prod. ,00081

3. ,9125 ounces  
20

dwt. 18,2500  
24

gr. 6,0000

18 dwt. 6 gr.

2. ,36 ton  
20  
7,20 cwt.  
4  
28,80 qr.  
28  
23040  
5760  
806,40 lb.  
16  
12902,40 oz.

4. 315)4,00(.0127 nearly

oz. dwt. gr.

5. 2 16 20=1364 grains

And 1 pound=5760 grains

Then, 5760)1364,0(.2368

6. *miles*  
,1392  
8

fur. 1,1136  
40

per. 4,5440  
5½

27200  
2720

yds. 2,9920

1 fur. 4 per. 3 yds.

11. 1 doll.=100 cts.  
3

15)300

3) 20

6⅔ cents

13. 222)1,000(.004504

7. 4)3,00(.75

8. 112)6,00(.0535714

9. 365)109,5(.3

10. ,04×50×1728=3456

12. *hhd.*  
,875  
63

2625  
5250

gall. 55,125  
4

qt. ,500  
2

pt. 1,000

55 gal. 1 pint

Page 55.

14. 365,25 days in a year  
    ,05

---

18,2625  
    24

---

730500  
365250

---

438,3000 hr.  
    60

---

26298,0 mi.  
    60

---

1577880 sec.15. ,73 ÷ (3 × ,25) that is  
    ,75),73(,973½16. 

<i>yr.</i>	<i>w.</i>	<i>d.</i>	<i>h.</i>	<i>m.</i>
,05=2	2	19	12	
<i>hr.</i>				
,5=0	0	0	30	

---

2w. 2d. 18h. 42mi.\*18. 

<i>A.</i>	<i>R.</i>	<i>P.</i>
,6	× 4	× 40 × ,02 = 1,92

17. 

<i>T.</i>	<i>h.</i>	<i>gal.</i>
,4	,3	,8
4		
1,9		
63		

---

120,5 gall.

---

4

---

482,0 qt.

---

2

---

964 pints19. 

<i>cub.in.</i>	<i>ft.</i>	<i>in.</i>
1 ÷ (128 × 1728)		that is
221184)	1,000000	(,000004 +

20. (28 deg. 48 min.) ÷ 360 deg.  
that is,  

<i>mi.</i>	<i>mi.</i>
21600)	1728,00(08

## SINGLE RULE OF THREE DIRECT.

Page 57.

<i>lb.</i>	<i>d.</i>	<i>c.</i>	<i>lb.</i>	<i>cts.</i>	<i>lb.</i>	
112	:	12,32	::	16	:	12,32 × 16

  
Quest. 2. As 112 : 12,32 :: 16 :  $\frac{12,32 \times 16}{112} = 1 \text{ d. } 76 \text{ c.}$ 

3. As 1 : 36 :: 336 (=3) : 120 doll. 96 cts.

4. 

<i>yds.</i>	<i>yds.</i>	<i>yds.</i>	<i>yds.</i>	<i>yds.</i>					
23	+	24	+	25	+	27	=	99	then

<i>yd.</i>	<i>cts.</i>	<i>yds.</i>							
As 1	:	72	::	99	:	99 × 72 = 71	dolls.	28	cts.

\*This answer is obtained by reckoning 12 months to the year, 4 weeks to the month, 7 days to a week, &c. But at 52 weeks to the year, the answer will be 2w. 4d. 4h. 18mi. And at 365½ days, it will be 2w. 4d. 5h. 48mi. the true Answer.

Page 57.

*lb. cts. lb.*

5. As 4 : 48 :: 512 (4 cwt. 2 qr. 8 lb.) : 61 dolls. 44 cts.

*lb. cts. lb.*

6. As 1 : 8 :: 128 : 10 dolls. 24 cts.

*pair d. c. pair*7. As 114 ( $=9\frac{1}{2}$  doz.) : 68,40 :: 3 : 1 doll. 80 cts.*bu. d. c. bu.*

8. As 20 : 9,60 :: 3 : 1 doll. 44 cts.

*cts. yd. d. cts.*

9. As 75 : 1 :: 16,50 : 22 yards.

*c. qr. lb. d. cts. oz. cts.*10. As 32080 ( $=17\ 3\ 17$ ) : 320,80 :: 6 : 6

Page 58.

*oz. lb. dol. oz. d. c.*11. As 116,4 ( $=9,7$ ) : 97 :: 1,5 :  $\frac{97 \times 1,5}{9,7 \times 12} = 1\ 25$ *acres dolls. acres*

12. As 125,5 : 627,5 :: 1 : 5 :: 4,75 : 23 doll. 75 cents.

*gal. dolls. cts. gal.*13. As 1,5 : 4 50 :: 378 ( $=1,5$  tuns) : 1134 dolls.*d. cts. d. cts. d. cts. d. cts.*

14. First 1 66 + 1 97 + 2 31 = 5 94 the price of 1 ream of each sort. Then say—

*d. cts. of each sort. d. cts.*

As 5 94 : 1 :: 528 66 : 89 reams of each sort.

*lb. T. d. lb. qr. lb.*15. As 2240 ( $=1$ ) : 224 :: 42 ( $=1\ 14$ ) : 4 dolls. 20 cts.*d. c. bbl. d. c.*

16. As 5 50 : 1 :: 1402,50 : 255 barrels

*da. d. cts. da.*

17. As 365 : 1186,25 :: 1 : 3 dolls. 25 cents.

Page 58.

18. As  $\overset{da.}{1} : \overset{d.}{2} \overset{cts.}{25} :: \overset{da.}{365} : 821 \text{ dolls. } 25 \text{ cents, the}$   
 sum he spends in a year.

Now,  $821 \text{ dol. } 25 \text{ cts.} + 378 \text{ dol. } 75 \text{ cts.} = 1200 \text{ dolls.}$

19.  $\overset{T.}{4} \overset{cwt.}{10} \overset{qr.}{1} \overset{lb.}{12} = 10120$

Then, as  $\overset{lb.}{112} : \overset{cts.}{1,12} :: \overset{lb.}{10120} : 101 \text{ dolls. } 20 \text{ cents.}$

20.  $4 \text{ ft. } 6 \text{ in.} = 54 \text{ inches}$   
 $\frac{1}{2} \text{ of } 54 = 27 \text{ add}$

—  
 81  
 27  
 —  
 2187  
 9  
 —

19683 solid inches

Then, as  $\overset{cu.in.}{1728} : \overset{cts.}{110} :: \overset{cu.in.}{19683} : 12 \text{ dolls. } 53 \text{ cts. nearly}$

21.  $\overset{in.}{(28+14)} \times \overset{in.}{14} \times \overset{in.}{3,5} = 2058 \text{ cubic inches}$

Then, as  $\overset{cu.in.}{1728} : \overset{cts.}{190} :: \overset{cu.in.}{2058} : \overset{d.cts.m.}{2 \text{ } 26 \text{ } 2+}$

22. One ton = 2240 lb.  $\overset{£.}{22} \overset{s.}{8} = 448 \text{ \& } \overset{T.}{203} \overset{cwt.}{9} \overset{qr.}{3} \overset{lb.}{3} = 455815$

Now, as  $\overset{lb.}{2240} : \overset{s.}{448} :: \overset{lb.}{5} : 1 :: \overset{s.}{455815} : 91163 = £4558 \text{ } 3s.$

23. As  $\overset{d.}{11} \overset{c.}{25} : \overset{yds.}{5} \text{ that is, as } 225 : 1 :: 850 \overset{d.}{50} : 378 \text{ in all}$   
 And, as  $18 \text{ pieces} : 378 \text{ yds.} :: 1 \text{ piece} : 21 \text{ yards}$

24. As  $\overset{hf.yds.}{25} (\overset{yds.}{=12\frac{1}{2}}) : \overset{d.}{450} (\overset{£.}{=1} \overset{s.}{17} \overset{d.}{6}) :: \overset{hf.yds.}{2} : \overset{d.}{36} = \overset{s.}{3}$

25. As  $\overset{ft.}{7} : \overset{ft.}{4} :: \overset{ft.in.}{218 \text{ } 9} : 125 \text{ feet}$

Page 58.

*A. R. P.*

26. 476 3 28=76308 perches. Then say

*P. d. c. P.*  
 As 76308 : 4292 32½ :: 160 : 9 dollars

*da. cts. da. d. cts.*  
 27. As 1 : 214 :: 365 : 781 10 spends

*dolls. cts.*  
 Then, from 1333 00 annual income  
           take 781 10 yearly expense

---

\$551 90 he will save

Page 59.

*bu. d. c. bu.*  
 28. As 321 : 240,75 :: 1 : 75 cents

*na. yds. cts. na. qr. na.*  
 29. As 24(=1½) : 250 :: 6(=1 2) : 62½ cents

*gal. gal. gal.*  
 30. 120½ + 124 + 126¾ = 371¼ gallons

*gal. d. s. d. gal. pence. £. s. d.*  
 As 1 : 66(=5 6) :: 371¼ : 24502½ = 102 1 10½

*mi. da. mi.*  
 31. 12 × 5 = 60 the distance that A has gone before B starts

*mi. mi.*  
 16—12=4 miles B gains on A per. day

*mi. da. mi.*  
 Then, as 4 : 1 :: 60 : 15 days

*£. d. s. d. £. pence £.*  
 32. As 1 : 150(=12 6) :: 1000 : 150000 = 625

*men bbls. men bbls. bbls.*  
 33. As 365 : 75 :: 500 : 102½ = 102½

34. This is properly a question belonging to the rule of Three Inverse, stated thus,

*cts. A. cts.*  
 As 375 : 360 :: 250 then,

*cts. A.*  
 375 × 360  


---

 250 cts. = 540 acres.

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$$35. \quad \begin{array}{ccccccc} \text{mi.} & \text{hrs.} & \text{mi.} & \text{deg.} & \text{mi.} & \text{mi.} & \text{fur.} \\ \text{As } 1440 (=24) & : & 25020 (=360 \times 69\frac{1}{2}) & : : & 1 & : & 17 \quad 3 \end{array}$$

## SINGLE RULE OF THREE INVERSE.

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$$\text{Quest. 2.} \quad \begin{array}{ccccc} \text{men} & \text{days} & \text{men} & & \text{men} & \text{days} & \text{men} \\ \text{As } 60 & : & 100 & : : & 20 & & 3. \quad \text{As } 65 & : & 4 & : : & 5 \end{array}$$

$$\begin{array}{r} 60 \\ \hline 2|0)600|0 \\ \hline 300 \text{ days} \end{array}$$

$$\begin{array}{r} 4 \\ \hline 5)260 \\ \hline 52 \text{ days} \end{array}$$

$$4. \quad \begin{array}{ccccc} \text{per.} & \text{days} & \text{per.} & & \\ \text{As } 6 & : & 24 & : : & 9 (=6+3) : \frac{6 \times 24}{9} = 16 \text{ days} \end{array}$$

$$5. \quad \begin{array}{ccccc} \text{cwt.} & \text{miles} & \text{cwt.} & & \\ \text{As } 1 & : & 150 & : : & 6 : \frac{1 \times 150}{6} = 25 \text{ miles} \end{array}$$

$$6. \quad \begin{array}{ccccc} \text{ft. wide} & \text{yds. long} & \text{ft. wide} & & \\ \text{As } 80 & : & 300 & : : & 60 : \frac{80 \times 300}{60} = 400 \text{ yards} \end{array}$$

$$7. \quad \begin{array}{ccccc} \text{r. l.} & \text{r. w.} & \text{r. l.} & & \\ \text{As } 80 & : & 30 & : : & 70 : \frac{80 \times 30}{70} = \frac{8 \times 30}{7} = 34 \text{ r. } 4 \text{ ft. } 8\frac{4}{7} \text{ in.} \end{array}$$

$$8. \quad \begin{array}{ccccc} \text{foot} & \text{feet} & \text{foot} & & \\ \text{As } 1 & : & 12 & : : & ,75 : \frac{12,00}{,75} = 16 \text{ feet} \end{array}$$

$$9. \quad \begin{array}{ccccc} \text{yd.} & \text{yds.} & \text{yd.} & & \\ \text{As } ,75 & : & 42,5 & : : & 1,25 : \frac{,75 \times 42,5}{1,25} = 25,5 \text{ yards} \end{array}$$

$$10. \quad \begin{array}{ccccc} \text{men} & \text{months} & \text{men} & & \\ \text{As } 10 & : & 4,5 & : : & 15 (=10+5) : \frac{10 \times 4,5}{15} = 3 \text{ months} \end{array}$$

$$11. \quad \begin{array}{ccccc} \text{dolls.} & \text{yrs.} & \text{dolls.} & & \\ \text{As } 80 & : & 15 & : : & 600 : \frac{80 \times 15}{600} = 2 \text{ years} \end{array}$$

$$12. \quad \begin{array}{ccccc} \text{hrs.} & \text{days} & \text{hrs.} & & \\ \text{As } 12 & : & 4 & : : & 16 : \frac{12 \times 4}{16} = 3 \text{ days} \end{array}$$

$$13. \quad \begin{array}{ccccc} \text{days} & \text{men} & \text{days} & & \\ \text{As } 30 & : & 400 & : : & 50 : \frac{30 \times 400}{50} = 240 \text{ the number of} \\ \text{men the provisions will serve fifty days} \end{array}$$

And  $400 - 240 = 160$  men must depart.

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$$14. \text{ As } \overset{\text{dolls.}}{292} : \overset{\text{mo.}}{6} :: \overset{\text{dolls.}}{806} : \frac{292 \times 6}{806} = 2 \text{ mo. } 5\frac{170}{806} \text{ da.}$$

$$15. \text{ As } \overset{\text{men}}{1200} : \overset{\text{mo.}}{9} :: \overset{\text{men}}{1600} (=1200+400) : \frac{1200 \times 9}{1600} = 6\frac{3}{4} \text{ mo.}$$

*Again,*

$$\text{As } \overset{\text{men}}{1200} : \overset{\text{oz.}}{14} :: \overset{\text{men}}{1600} : \frac{1200 \times 14}{1600} = 10\frac{1}{2} \text{ allowance per day}$$

And  $14 \text{ oz.} - 10\frac{1}{2} \text{ oz.} = 3\frac{1}{2} \text{ oz.}$  diminution required.

$$16. \text{ As } \overset{\text{rod}}{40} : \overset{\text{rod}}{4} :: \overset{\text{rod}}{25} : \frac{40 \times 4}{25} = 6\frac{2}{5} \text{ rods.}$$

$$17. \text{ As } \overset{\text{in.}}{12} : \overset{\text{in.}}{12} :: \overset{\text{in.}}{3} : \frac{12 \times 12}{3} = 48 \text{ inches.}$$

$$18. \text{ As } \overset{\text{cws.}}{6} : \overset{\text{days}}{91} :: \overset{\text{cws.}}{21} : \frac{6 \times 91}{21} = 26 \text{ days.}$$

$$19. \text{ As } \overset{\text{mi.}}{600} (=10) : \overset{\text{hrs.}}{1} :: \overset{\text{pipe}}{24} : \frac{600}{24} = 25 \text{ pipes.}$$

$$20. \text{ As } \overset{\text{inches}}{216} (=18) : \overset{\text{ft.}}{10} (=30) :: \overset{\text{in.}}{18} (= \frac{1}{2}) : \frac{216 \times 10}{18} = 120 \text{ yds.}$$

$$21. \text{ As } \overset{\text{in.}}{75} (= \frac{3}{4}) : \overset{\text{lb.}}{208} :: \overset{\text{in.}}{39} : \frac{75 \times 208}{39} = 4 \text{ lb.}$$

$$22. \overset{\text{da.}}{5} \times \overset{\text{mi.}}{20} = 100 \text{ A has gone before B starts.}$$

$$\overset{\text{mi.}}{25} - \overset{\text{mi.}}{20} = 5 \text{ miles B gains on A each day.}$$

$$\text{Now, as } \overset{\text{mi. da.}}{5} : \overset{\text{mi. da.}}{1} :: \overset{\text{mi. da.}}{100} : \overset{\text{mi. da.}}{20} \text{ B will overtake A.}$$

$$\text{And } \overset{\text{da. mi.}}{20} \times \overset{\text{mi.}}{25} = 500 \text{ the distance B must travel.}$$

## GENERAL RULE.

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*Quest. 3.* As  $\overset{\text{mo.}}{5} : \overset{\text{mo.}}{2} :: \overset{\text{men}}{800} : \frac{800 \times 2}{5} = 320$  the number of men the provisions will serve for five months.

'Then,  $800 \text{ men} - 320 \text{ men} = 480 \text{ men}$  must depart.



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$$4. \quad \begin{array}{c} \text{galls.} \quad \text{galls.} \quad \text{galls.} \\ 63 - 9 = 54 \text{ remains} \end{array}$$

$$\begin{array}{c} \text{dolls.} \quad \text{dolls.} \quad \text{dolls.} \\ \text{And } 119 + 12 = 131 \text{ must sell for} \end{array}$$

$$\begin{array}{c} \text{gal.} \quad \text{gal.} \quad \text{dol.} \quad \text{d.} \quad \text{c.} \quad \text{m.} \\ \text{Then, as } 54 : 1 :: 131 : \frac{131}{54} = 2 \quad 42 \quad 5\frac{50}{54} \end{array}$$

$$5. \quad \begin{array}{c} \text{mi.} \quad \text{mi.} \quad \text{lb.} \quad \text{lb.} \\ \text{As } 64 : 512 \text{ that is, as } 1 : 8 :: 225 : 1800 \end{array}$$

$$6. \quad \begin{array}{c} \text{dolls.} \quad \text{dolls.} \quad \text{cts.} \quad \text{cts.} \\ \text{As } 1750 : 10 \therefore 175 : 1 :: 8750 : 50 \end{array}$$

*Promiscuous Questions in Direct and Inverse Proportion.*

$$\text{Quest. 1. As } \begin{array}{c} \frac{1}{2} \text{mi.} \quad \text{mi.} \quad \text{hr.} \quad \frac{1}{2} \text{mi.} \quad \text{mi.} \quad \text{hr.} \quad \text{mi.} \\ 5 (=2\frac{1}{2}) : 1 :: 246 (=123) : 49 \quad 12 \text{ going} \end{array}$$

$$\text{And, as } \begin{array}{c} \frac{1}{2} \text{mi.} \quad \text{mi.} \quad \text{hr.} \quad \frac{1}{2} \text{mi.} \quad \text{hrs.} \quad \text{mi.} \quad \text{sec.} \\ 7 (=3\frac{1}{2}) : 1 :: 246 : 35 \quad 8 \quad 34\frac{2}{7} \text{ returning} \end{array}$$

$$\begin{array}{r} \text{hrs.} \quad \text{mi.} \quad \text{sec.} \\ \text{But } 49 \quad 12 \quad 0 \\ \quad 35 \quad 8 \quad 34\frac{2}{7} \\ \hline \end{array}$$

$$\text{Sum } 84h. 20mi. 34\frac{2}{7}sec.$$

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$$\text{Quest. 2. Stated thus, as } \begin{array}{c} \text{dolls.} \quad \text{da.} \quad \text{dolls.} \\ 1000 : 189 :: 650 \text{ Inverse pro.} \end{array}$$

$$\begin{array}{c} \text{dolls.} \quad \text{dolls.} \quad \text{days.} \\ \text{Or, as } 650 : 1000 : 189 \text{ by the general rule} \end{array}$$

$$\begin{array}{c} \text{dolls.} \quad \text{da.} \quad \text{da.} \\ \text{Then } \frac{1000 \times 189}{650 \text{ dolls.}} = \frac{20 \times 189}{13} = 290\frac{10}{13} \text{ days.} \end{array}$$

$$3. \quad \begin{array}{c} \text{cwt.} \quad \text{qr.} \quad \text{lb.} \quad \text{casks} \quad \text{lb.} \quad \text{cwt.} \quad \text{lb.} \quad \text{cwt.} \quad \text{lb.} \\ (1 \quad 1 \quad 4) \times 14 = 144 \times 14 = 2016 \quad 1 = 112 \end{array}$$

$$\begin{array}{c} \text{lbs.} \quad \text{cts.} \quad \text{lbs.} \\ \text{Then, as } 112 : 1260 :: 2016 : \frac{12,60 \times 2016}{112} = 226d. 80c. \end{array}$$

$$\begin{array}{c} \text{lbs.} \quad \text{cts.} \quad \text{lb.} \\ \text{And, as } 112 : 1260 :: 1 : \frac{1260}{112} = \frac{45}{4} = 11 \text{ cts. } 2\frac{1}{2} \text{ ms.} \end{array}$$

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4.  $\begin{matrix} \text{cwt.} & \text{qr.} & \text{lb.} & \text{chests.} & \text{lb.} & \text{chest.} & \text{lb.} \\ (1 & 0 & 14) \times 4 = 126 \times 4 = 504 \end{matrix}$  the whole weight.

					<i>dolls.</i>	<i>cts.</i>
Now, as	1 lb. :	80 cts. ::	126 lb. :	100	80	
	1 lb. :	90 cts. ::	126 lb. :	113	40	
	1 lb. :	105 cts. ::	126 lb. :	132	30	
	1 lb. :	125 cts. ::	126 lb. :	157	50	

---

\$504 00 the amt.

Then, as 504 lb. : 504 dolls. :: 1 lb. : 1 dollar

5. 5oz.  $\times 12 = 60$  ounces of bread in a dozen of rolls.

And, as 5 : 4 :: 60 oz. : 48 oz. the weight of flour in a dozen of rolls.

Then, as  $\begin{matrix} \text{oz.} & \text{cwt.} & \text{dolls.} & \text{oz.} \\ 1792 (=1) : 224 \therefore 8 : 1 :: 48 : 6 \text{ cts.} \end{matrix}$

	<i>dolls.</i>	<i>cts.</i>
6. Cost	780	00
Freight	37	70
Other charges	30	60
Gain	143	00

---

\$991 30 cts. must sell the whole for

Then, as  $\begin{matrix} \text{bbl.} & \text{dolls.} & \text{cts.} & \text{bbl.} \\ 270 : 991 & 30 :: 1 : 3 \text{ dolls. } 67\frac{4}{27} \text{ cts.} \end{matrix}$

7. Half a ton = 10 cwt. = 40 qrs.

As  $\begin{matrix} \text{horses} & \text{qrs.} & \text{horses} \\ 80 : 40 :: 7 : \frac{40 \times 7}{80} = \frac{7}{2} = 3 \text{ qrs. } 14 \text{ lb.} \end{matrix}$

*Quest.* 8. 12ft. = 144 inches, and 9ft. 3in. = 111 inches, 144in.  $\times 111$  in. = 15984 inches. In that distance the large wheel will have made 111 revolutions and the smaller 144 turns. But 144—111 = 33 turns of the less more than the greater in that distance. Now, as 33 turns : 15984 inches distance :: 1000 turns : 484363  $\frac{7}{11}$  inches; this, when reduced to miles, is 7 miles, 5 furlongs, 34 yards, 1 foot, 7  $\frac{7}{11}$  inches.

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*Quest. 9.* This question being inverse, say  
 As  $\overset{\text{hrs.}}{15} : \overset{\text{da.}}{18} :: \overset{\text{hrs.}}{12} : \frac{15 \times 18}{12} = \frac{15 \times 3}{2} = 22\frac{1}{2}$  days.

10. As  $\overset{\text{yds.}}{42,5} : \overset{\text{dolls. cts.}}{191,25} \therefore 1 : 4,5 :: \overset{\text{yds.}}{15} : 67$  dolls. 50 cts.  
 what 15 yards cost; but  $\frac{2}{3}$  of 67 dolls. 50 cts. = 45 dolls. the  
 amount that 15 yards sells for.

Now,  $42\frac{1}{2}$  yards at 1 dollar, comes to 42 dollars 50 cents,  
 whole gain.

$\overset{\text{d. cts.}}{191\ 25} + \overset{\text{d. cts.}}{42,50} = \overset{\text{d. cts.}}{233,75}$  must get in all  
 Subtract 45,00 received for 15 yards.

Diff. \$188,75 the sum that the remaining  
 $27\frac{1}{2}$  yards must bring. But

$\overset{\text{yds.}}{27,5} : \overset{\text{d. c.}}{188,75} :: \overset{\text{yd.}}{1} : \overset{\text{d. c.}}{6,86\frac{4}{11}}$

11. State by the general rule

$\overset{\text{yds.}}{60} : \overset{\text{yds.}}{10} (=30) \therefore \overset{\text{ft.}}{6} : 1 :: \overset{\text{ft.}}{18} : 3$  feet

12. As  $\overset{\text{rod.}}{40} : \overset{\text{rod.}}{640} (=160 \times 4) :: \overset{\text{rod. A.}}{1} : \overset{\text{rod. rods.}}{16}$

Or, As  $\overset{\text{rod.}}{40} : \overset{\text{rod.}}{160} \therefore \overset{\text{rod. rods.}}{1} : 4 :: 4 : 16$

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13. Because the large wheel has 70 cogs, and the small  
 one 52, the small wheel will make 70 revolutions while the  
 large ones make 52. But  $70 - 52 = 18$  revolutions that the  
 small wheel will gain in the same time. Then say,

As  $\overset{\text{rev.}}{18} : \overset{\text{rev.}}{52} :: \overset{\text{rev.}}{100} : \frac{52 \times 100}{18} = 288\frac{8}{9}$  revolutions

14.  $\overset{\text{feet.}}{1142} \times \overset{\text{sec.}}{60} = \overset{\text{feet.}}{68520}$  the dist. sound goes in a minute.

Then, as  $\overset{\text{pul.}}{70} : \overset{\text{feet.}}{68520} :: \overset{\text{pul.}}{20} : \overset{\text{feet.}}{19577\frac{1}{7}} = \overset{\text{m. f. yds. ft.}}{3\ 5\ 145\ 2\frac{1}{7}}$

15.  $5 + 4 + 3 + 2 + 1 = 15$  the cost of 1 yard of each sort.

Then, as  $\overset{\text{dolls.}}{15} : 1 :: \overset{\text{dolls. cts.}}{532,50} : \overset{\text{yds.}}{35\frac{1}{2}}$

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16. Stated by the general rule it will be

$$\begin{array}{cccc} \text{mo.} & \text{mo.} & \text{dolls.} & \text{dolls.} \\ \text{As } 1 & : 12 & :: 127 & : 1524 \end{array}$$

$$17. \quad \begin{array}{cccc} \text{in.} & \text{in.} & \text{lb.} & \\ \text{As } ,5 & : 36 & :: 5 & : \frac{36 \times 5}{,5} = 360 \text{ pounds.} \end{array}$$

$$18. \quad \begin{array}{cccc} \text{lb.} & \text{lb.} & & \text{in.} \\ \text{As } 90 & : 5 & \therefore 18 & : 1 :: 36 : 2 \text{ inches} \end{array}$$

19.  $\frac{4}{5} = ,8$  and  $\frac{1}{2} = ,5$  therefore it will be

$$\begin{array}{cccccc} \text{yd.} & \text{dolls.} & \text{yds.} & \text{d.} & \text{c.} & \text{m.} \\ \text{As } 1 & : 2,7118 & :: 67,5 & : 183 & 04 & 6\frac{1}{2} \end{array}$$

$$20. \quad \begin{array}{cccc} \text{day} & \text{s.} & \text{d.} & \text{qr.} \\ 1 & : 16 & 5 & 1\frac{15}{365} \end{array} \quad \begin{array}{c} \text{days.} \\ : : 365 \end{array}$$

12

197

4

789

365

3950

4735

2367

$$4 \ ) \ 238000^*$$

$$12 \ ) \ 72000$$

$$2 \ | \ 0 \ ) \ 600 \ | \ 0$$

300l.

\* Here omit multiplying by the third number, because you would immediately have to divide by the same number, to bring farthings.

$$21. \quad \begin{array}{cccccc} \text{yds.} & \text{qrs.} & \text{ft.} & \text{ft.} & \text{sq. ft.} & \\ 11 \times 3 = 33 \times 2\frac{1}{4} = 74,25 & \text{in a piece.} \end{array}$$

$$\text{And } 2 \ (25 + 15) \times 10\frac{1}{2} = 80 \times 10\frac{1}{2} = 840$$

$$\text{But } \begin{array}{cccc} \text{sq. feet} & 840 & \text{sq. ft.} & \text{sq. ft.} \\ 840 - \frac{840}{10} = 840 - 84 = 756 & \text{in the walls.} \end{array}$$

$$\text{Then, as } \begin{array}{cccc} \text{sq. ft.} & \text{piece} & \text{sq. ft.} & \\ 74,25 & : 1 & :: 756 & : 10\frac{2}{11} \text{ pieces} \end{array}$$

$$22. \quad \begin{array}{cccc} \text{ft.} & \text{ft.} & \text{in.} & \text{ft.} \\ \text{As } 50 & : 50 & 10\frac{1}{2} & :: 1287 & 4, \text{ that is} \end{array}$$

$$\text{As } \begin{array}{cccccc} \text{in.} & \text{in.} & \text{in.} & \text{in.} & \text{ft.} & \text{in.} \\ 600 & : 610\frac{1}{2} & :: 15448 & : 15718\frac{17}{50} = 1309 & 10\frac{17}{50} \end{array}$$

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23. As  $16 \overset{h. pt.}{=} \overset{gal.}{1} : 15 \overset{h. pt.}{:} \overset{gal.}{:} 100 : 93\frac{3}{4}$  gallons

## DOUBLE RULE OF THREE.

Believing that it will be acceptable to some, I here insert two rules for stating the Double Rule of Three, in addition to that in the W. Calculator.

**RULE FIRST.** Place the three conditional terms in the following order: that which is the principal cause of gain, loss or action, possesses the first place; that which denotes space of time, or distance of place, the second; and that which is the gain, loss, or action the third; then place the other two terms, which move the question, under those of the same name, and if the blank space falls under the third, multiply the three last terms for a dividend, and the two first for a divisor: but if the blank fall under the first or second place, multiply the first, second, and last terms together for a dividend, and the other two for a divisor; and the quotient will be the answer.

**RULE SECOND.** Work by two statements of the Single Rule of Three.

## DIRECT PROPORTION.

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*Quest. 2.*       $\left. \begin{array}{ll} \text{Horses} & 18 \\ \text{days} & 20 \end{array} \right\} 10 \text{ bushels.} \quad \left\{ \begin{array}{ll} 60 \text{ horses} \\ 36 \text{ days} \end{array} \right.$

Then  $\frac{10 \times 60 \times 36}{18 \times 20} = 10 \times 3 \times 2 = 60$  bushels.

Or thus,

$\begin{array}{lll} \text{horses} & \text{days} & \text{bu.} \\ \text{As } 18 & : 20 & :: 10 \\ 60 & : 36 & \end{array} \quad \text{Then } \frac{10 \times 60 \times 36}{18 \times 20} = 60 \text{ bushels.}$

Or, by two statings,

$\begin{array}{lll} \text{horses} & \text{bu.} & \text{horses} \\ \text{As } 18 & : 10 & :: 60 : 33\frac{1}{3} \text{ bushels.} \end{array}$

$\begin{array}{lll} \text{days} & \text{bu.} & \text{days bushels.} \\ \text{And, as } 20 & : 33\frac{1}{3} & :: 36 : 60 \text{ as before.} \end{array}$

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Stated thus,

$$3. \quad \begin{array}{l} \text{Men } 7 \\ \text{days } 14 \end{array} \left. \vphantom{\begin{array}{l} \text{Men } 7 \\ \text{days } 14 \end{array}} \right\} 56 \text{ lb.} \quad \left\{ \begin{array}{l} 21 \text{ men} \\ 3 \text{ days} \end{array} \right.$$

Or thus,

$$\begin{array}{l} \text{men days lbs.} \\ 7-14-56 \\ 21-3 \end{array}$$

$$\text{Then } \frac{56 \times 21 \times 3}{7 \times 14} = 4 \times 3 \times 3 = 36 \text{ pounds}$$

Or by two statings,

$$\text{As } \begin{array}{l} \text{men} \quad \text{men} \quad \text{lb.} \\ 7 : 21 :: 56 : 158, \text{ and} \end{array}$$

$$\text{As } \begin{array}{l} \text{days} \quad \text{days} \quad \text{lb.} \\ 14 : 3 :: 168 : 36 \text{ pounds.} \end{array}$$

Stated thus,

$$4. \quad \begin{array}{l} \text{Students } 8 \\ \text{months } 6 \end{array} \left. \vphantom{\begin{array}{l} \text{Students } 8 \\ \text{months } 6 \end{array}} \right\} \begin{array}{l} \text{dolls.} \\ 384 \end{array} \left\{ \begin{array}{l} 12 \text{ stud.} \\ 10 \text{ mo.} \end{array} \right.$$

Or thus,

$$\begin{array}{l} \text{stu. mo. dolls.} \\ 8-6-384 \\ 12-10 \end{array}$$

$$\text{Then, } \frac{384 \times 12 \times 10}{8 \times 6} = 48 \times 2 \times 10 = 960 \text{ dollars.}$$

Or by two statings,

$$\text{As } \begin{array}{l} \text{stu.} \quad \text{stu.} \quad \text{dolls.} \quad \text{dolls.} \\ 8 : 12 :: 384 : 576, \text{ and} \end{array}$$

$$\text{As } \begin{array}{l} \text{mo.} \quad \text{mo.} \quad \text{dolls.} \\ 6 : 10 :: 576 : 960 \text{ dollars.} \end{array}$$

Stated thus,

$$5. \quad \begin{array}{l} \text{Cwt. } 20 \\ \text{miles } 50 \end{array} \left. \vphantom{\begin{array}{l} \text{Cwt. } 20 \\ \text{miles } 50 \end{array}} \right\} \begin{array}{l} \text{dolls.} \\ 25 \end{array} \left\{ \begin{array}{l} 40 \text{ cwt.} \\ 100 \text{ miles} \end{array} \right.$$

Or thus,

$$\begin{array}{l} \text{cwt.} \quad \text{mi.} \quad \text{dolls.} \\ 20-50-25 \\ 40-100 \end{array}$$

$$\text{Then, } \frac{25 \times 40 \times 100}{20 \times 50} = 25 \times 2 \times 2 = 100 \text{ dollars.}$$

Or by two statings,

$$\text{As } \begin{array}{l} \text{cwt.} \quad \text{cwt.} \quad \text{dolls.} \quad \text{dolls.} \\ 20 : 40 :: 25 : 50, \text{ and} \end{array}$$

$$\text{As } \begin{array}{l} \text{miles} \quad \text{miles} \quad \text{dolls.} \\ 50 : 100 :: 50 : 100 \text{ dollars.} \end{array}$$

Stated thus,

$$6. \quad \begin{array}{l} \text{Dolls. } 700 \\ \text{months } 6 \end{array} \left. \vphantom{\begin{array}{l} \text{Dolls. } 700 \\ \text{months } 6 \end{array}} \right\} \begin{array}{l} \text{dolls.} \\ 14 \end{array} \left\{ \begin{array}{l} 400 \text{ dolls.} \\ 60 \text{ mo.} \end{array} \right.$$

Or thus,

$$\begin{array}{l} \text{dolls. mo. dolls.} \\ 700-6-14 \\ 400-60 \end{array}$$

$$\text{Then, } \frac{14 \times 400 \times 60}{700 \times 6} = 2 \times 4 \times 10 = 80 \text{ dolls.}$$

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Or by two statings,

*dolls. dolls. dolls. dolls. mo. mo. dolls.*  
 As 700 : 400 :: 14 : 8 and, As 6 : 60 :: 8 : 80 d.

Statement,

7. Men 4 } *rods* { 8 men  
           12 }  
 days 6 } { 24 days

Or thus,

*men days rods*  
 4—6—12  
 8—24

Then,  $\frac{12 \times 8 \times 24}{4 \times 6} = 2 \times 8 \times 6 = 96$  rods.

Or by two statings,

*men men rods rods da. days rods*  
 As 4 : 8 :: 12 : 14 and, As 6 : 24 :: 24 : 96 rods.

## INVERSE PROPORTION.

Stated thus,

*Quest. 2. Men 4 inverse } days { 16 men inverse*  
                                   3 }  
       *Dolls. 24 } { 384 dolls.*

Or thus,

*men days dolls.*  
 4—3—24  
 16— —384

Then,  $\frac{3 \times 4 \times 384}{16 \times 24} = 3 \times 4 \times 1 = 12$  days

Or by two statings,

*dolls. dolls. days days men men days days*  
 As 24 : 384 :: 3 : 48 and, As 16 : 4 :: 48 : 12

3. *Dolls. 24 } men { 96 dollars*  
       4 }  
*day 3 inverse } { inverse 16 days.*

*men days dolls.*  
 4—3—24  
 16—96

Then,  $\frac{4 \times 96 \times 3}{24 \times 16} = \frac{4 \times 4 \times 3}{16} = 3$  men.

Or by two statings,

*dolls. dolls. men men days days men men*  
 As 24 : 96 :: 4 : 16 and, As 16 : 3 :: 16 : 3

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Stated thus,

$$4. \quad \begin{array}{l} \text{Acr. 84} \\ \text{inv. days 12} \end{array} \left\{ \begin{array}{l} \text{men} \\ 7 \end{array} \right\} \begin{array}{l} \left\{ \begin{array}{l} 100 \text{ acres} \\ 5 \text{ days inverse} \end{array} \right. \end{array}$$

Or thus,

$$\begin{array}{l} \text{men days acres} \\ 7-12-84 \\ 5-100 \end{array}$$

$$\text{Then, } \frac{7 \times 100 \times 12}{84 \times 5} = \frac{1 \times 20 \times 1}{1 \times 1} = 20 \text{ men}$$

Or by two statings,

$$\begin{array}{ccccccc} \text{acres} & \text{acres} & \text{men} & \text{men} & & \text{days} & \text{days} & \text{men} & \text{men} \\ \text{As } 84 : 100 :: 7 : 8\frac{1}{2} \text{ and, } & \text{As } 5 : 12 :: 8\frac{1}{2} : 20 \end{array}$$

Stated thus,

$$5. \quad \begin{array}{l} \text{Men inv. 7} \\ \text{acres 84} \end{array} \left\{ \begin{array}{l} \text{days} \\ 12 \end{array} \right\} \begin{array}{l} \left\{ \begin{array}{l} 20 \text{ men inv.} \\ 100 \text{ acres} \end{array} \right. \end{array}$$

Or thus,

$$\begin{array}{l} \text{men days acres} \\ 7-12-84 \\ 20-0-100 \end{array}$$

$$\text{Then, } \frac{12 \times 7 \times 100}{20 \times 84} = \frac{1 \times 1 \times 5}{1 \times 1} = 5 \text{ days}$$

Or by two statings,

$$\begin{array}{ccccccc} \text{acres} & \text{days} & \text{acres} & \text{days} & & \text{men} & \text{men} & \text{days} \\ \text{As } 84 : 12 :: 100 : 14\frac{2}{7} \text{ and, } & \text{As } 20 : 7 :: 14\frac{2}{7} : 5 \text{ days} \end{array}$$

Stated thus,

$$6. \quad \begin{array}{l} \text{Inverse 200 lb.} \\ 40 \text{ cts.} \end{array} \left\{ \begin{array}{l} \text{miles} \\ 40 \end{array} \right\} \begin{array}{l} \left\{ \begin{array}{l} 20200 \text{ lb. inverse} \\ 6060 \text{ cents.} \end{array} \right. \end{array}$$

$$\begin{array}{ccc} \text{lbs.} & \text{miles} & \text{cts.} \\ \text{Or thus, } & 200-40- & 40 \\ & 20200- & 0-6060 \end{array}$$

$$\text{Then, } \frac{40 \times 200 \times 6060}{2020 \text{ lb} \times 40 \text{ c.}} = 60 \text{ miles.}$$

Or by two statings,

$$\begin{array}{ccccccc} \text{cts.} & \text{mi.} & \text{cts.} & \text{miles} \\ \text{As } 40 : 40 :: 6060 : 6060 \text{ and,} \end{array}$$

$$\begin{array}{ccccccc} \text{lb.} & \text{lb.} & \text{miles} \\ \text{As } 20200 : 200 :: 6060 : 60 \text{ miles.} \end{array}$$

Stated thus,

$$7. \quad \begin{array}{l} \$200 \\ \text{inv. men 5} \end{array} \left\{ \begin{array}{l} \text{w. d.} \\ 22 \text{ 6} \end{array} \right\} \begin{array}{l} \left\{ \begin{array}{l} 300 \text{ dolls} \\ 12 \text{ men inv.} \end{array} \right. \end{array}$$

Or thus,

$$\begin{array}{l} \text{men w. d. dolls.} \\ 5-22 \text{ 6}-200 \\ 12-0-300 \end{array}$$

$$\text{Then, } \frac{(22 \text{ w. } 6 \text{ da.}) \times 300 \times 5}{200 \times 12} = 14 \text{ weeks } 2 \text{ days.}$$



Page 67.

Or by two statings,

*dolls. dolls. w. d. w. d.*  
As 200 : 300 :: 22 6 : 34 2 and,

*men men w. d. w. d.*  
As 12 : 5 :: 34 2 : 14 2

## PROMISCUOUS QUESTIONS.

Quest. 1. Stated thus,

12 oxen } *acres* { 24 oxen  
8 days } 10 { 48 days

Or thus,

*oxen days acres*  
12— 8—10  
24—48— 0

Then,  $\frac{10 \times 24 \times 48}{12 \times 8} = 120$  acres.

Or by two statings,

*ox. ox. acres acres days days acres*  
As 12 : 24 :: 10 : 20 and, As 8 : 48 :: 20 : 120 acres

2. *wt. wt. wt.*  
8000—4500=3500 and 9 days—6 days=3 days  
4500 cwt } *horses* { 3500 cwt.  
inverse 6 days } 18 { 3 days inverse

Or thus, *horses days cwt.*  
18—6—4500  
0—3—3500

Then,  $\frac{18 \times 3500 \times 6}{4500 \times 3} = 28$  horses.

Or by two statings,

*cwt. cwt. hor. hor. days days hor. hor.*  
As 4500 : 3500 :: 18 : 14 and, As 3 : 6 :: 14 : 28

3. *cwt. hhd. cwt. cwt. bbl. cwt.*  
12×9=108, and 2,5×50=125

Stated thus,

108 cwt. } *dolls.* { 125 cwt.  
60 miles } 100 { 300 miles

Or thus, *cwt. mi. dolls.*  
108—60—100  
125—300— 0

Then,  $\frac{100 \times 125 \times 300}{108 \times 60} = 578$  dolls.  $70\frac{10}{27}$  cents.

Or by two statings,

*mil. mil. dolls. dolls.*  
As 60 : 300 :: 100 : 500 and,

*cwt. cwt. dolls. dolls. cts.*  
As 108 : 125 :: 500 : 578  $70\frac{10}{27}$

Page 67.

$$4. \quad \begin{array}{l} 3 \text{ yds.} \\ 5 \text{ qrs.} \end{array} \left. \vphantom{\begin{array}{l} 3 \\ 5 \end{array}} \right\} \text{ lb. } \left\{ \begin{array}{l} 45 \text{ yds.} \\ 4 \text{ qrs.} \end{array} \right.$$

$$\text{Or,} \quad \begin{array}{r} \text{yds. - qrs. lb.} \\ 3-5-1 \\ 45-4-0 \end{array}$$

$$\text{Then, } \frac{1 \times 45 \times 4}{3 \times 5} = 12 \text{ yards}$$

By two statings,

$$\begin{array}{cccc} \text{yds.} & \text{yds.} & \text{lb.} & \text{lb.} \\ \text{As } 3 & : 45 & :: 1 & : 15 \text{ and,} \end{array} \quad \begin{array}{cccc} \text{qrs.} & \text{qrs.} & \text{lb.} & \text{lb.} \\ \text{As } 5 & : 4 & :: 15 & : 12 \end{array}$$

Or thus,

$$5. \quad \begin{array}{l} 240 \text{ miles} \\ \text{inverse 12 hours} \end{array} \left. \vphantom{\begin{array}{l} 240 \\ \text{inverse 12} \end{array}} \right\} \text{ days } \left\{ \begin{array}{l} 720 \text{ miles} \\ 16 \text{ hrs. inv.} \end{array} \right. \quad \begin{array}{l} \text{mil. days hrs.} \\ 240-12-12 \\ 720-0-16 \end{array}$$

$$\text{Then, } \frac{12 \times 720 \times 12}{240 \times 16} = \frac{12 \times 3 \times 12}{16} = 27 \text{ days.}$$

By two statings,

$$\begin{array}{cccccc} \text{miles} & \text{miles} & \text{days} & \text{days} & \text{hrs.} & \text{hrs.} & \text{days} \\ \text{As } 240 & : 720 & :: 12 & : 36 \text{ and,} & \text{As } 16 & : 12 & :: 36 : 27 \text{ days} \end{array}$$

$$6. \quad \begin{array}{l} 16,5 \text{ feet} \\ 1,5 \text{ feet} \\ 1 \text{ foot} \end{array} \left. \vphantom{\begin{array}{l} 16,5 \\ 1,5 \\ 1 \end{array}} \right\} \text{ dolls. cts. } \left\{ \begin{array}{l} 30 \text{ feet} \\ 26 \text{ feet} \\ 4,5 \text{ feet} \end{array} \right. \quad \begin{array}{l} 1 \\ 25 \end{array}$$

$$\text{Then, } \frac{1,25 \times 30 \times 26 \times 4,5}{16,5 \times 1,5 \times 1} = 177 \text{ } 27 \frac{3}{4} \text{ dolls. cts.}$$

$$7. \quad \begin{array}{l} 8 \text{ feet} \\ 4 \text{ feet} \\ 4 \text{ feet} \end{array} \left. \vphantom{\begin{array}{l} 8 \\ 4 \\ 4 \end{array}} \right\} 1 \text{ cord } \left\{ \begin{array}{l} 200 \text{ feet long} \\ 10 \text{ feet high} \\ 36 \text{ feet broad} \end{array} \right.$$

$$\text{Then, } \frac{1 \times 200 \times 10 \times 36}{8 \times 4 \times 4} = 562 \frac{1}{2} \text{ cords}$$

$$8. \quad \begin{array}{l} 10 \text{ yards} \\ 6 \text{ qrs.} \end{array} \left. \vphantom{\begin{array}{l} 10 \\ 6 \end{array}} \right\} \text{ lb. } \left\{ \begin{array}{l} 100 \text{ yards} \\ 3 \text{ qrs.} \end{array} \right.$$

$$\text{Then, } \frac{3 \times 100 \times 3}{10 \times 6} = 15 \text{ pound.}$$

Page 68.

$$9. \quad \begin{array}{l} \text{Inv. 24 men} \\ 200 \text{ ft. long} \\ 8 \text{ ft. high} \\ 6 \text{ ft. thick} \end{array} \left. \vphantom{\begin{array}{l} 24 \\ 200 \\ 8 \\ 6 \end{array}} \right\} \text{ days } \left\{ \begin{array}{l} 6 \text{ men inverse} \\ 20 \text{ feet long} \\ 6 \text{ feet high} \\ 4 \text{ feet thick} \end{array} \right. \quad \begin{array}{l} 80 \end{array}$$

$$\text{Then, } \frac{80 \times 24 \times 20 \times 6 \times 4}{6 \times 200 \times 8 \times 6} = 16 \text{ days}$$

Page 63.

10. 9 persons } *dolls.* { 14 (=9+5) persons  
 5 months } 450 { 8 months

Then,  $\frac{450 \times 14 \times 8}{9 \times 5} = 1120$  dollars

11. 8 persons } *dolls.* { 12 (=8+4) persons  
 1 month }  $11\frac{1}{4}$  { 6 months  
 10 dollars } { 11 dollars

Then,  $\frac{11\frac{1}{4} \times 12 \times 6 \times 11}{8 \times 10} = 111\ 37\frac{1}{2}$  *dolls. cts.*

12. 22,5 feet long } *days* { 45 feet long  
 17,3 feet wide } { 34,6 feet wide  
 10,25 ft. deep } 2,5 { 12,3 feet deep  
 Inverse 6 men } { 9 men inverse  
 Inverse 12,3 hours } { 8,2 days inverse

Then,  $\frac{2,5 \times 45 \times 34,6 \times 12,3 \times 6 \times 12,3}{22,5 \times 17,3 \times 10,25 \times 9 \times 8,2}$  by cancelling\*

$= \frac{2,5 \times 2 \times 2 \times 12,3}{10,25} = \frac{123}{10,25} = 12$  days.

## PRACTICE.

Case 1. Page 69.

<i>d. cts.</i> 2. 1,75 250 yards <hr style="width: 100px; margin: 5px 0;"/> 8750 350 <hr style="width: 100px; margin: 5px 0;"/> \$437,50	<i>cts.</i> Or, 50 25	$\frac{1}{2}$ $\frac{1}{2}$	250 125 62,50 <hr style="width: 100px; margin: 5px 0;"/> \$437,50
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\**Cancelling.* That is, when the divisor and dividend are the continued product of a number of factors, you can divide both by the same divisor; and the operation will be greatly abridged.

Thus, in the above example, I observe that 22,5 goes into 45 twice, without a remainder; that 17,3 is contained twice, in 34,6; and that  $9 \times 8,2$  goes once into  $6 \times 12,3$ . Now, by dividing the numerator and denominator by these divisors, we obtain  $\frac{2,5 \times 2 \times 2 \times 12,3}{10,25}$  as above.

Page 69.

$$\begin{array}{r} 3. \quad 201 \text{ yds} \\ \quad 4,20 \\ \hline \end{array}$$

$$\begin{array}{r} 4020 \\ \hline \end{array}$$

$$\begin{array}{r} 804 \\ \hline \end{array}$$

$$\begin{array}{r} \$844,20 \\ \hline \end{array}$$

$$\begin{array}{r} \text{Or, } 201 \text{ yds.} \\ \quad 4 \\ \hline \end{array}$$

$$\begin{array}{r} 804 \\ \hline \end{array}$$

$$20 \text{ cts. is } \frac{1}{5} = 40,2$$

$$\begin{array}{r} \$844,20 \\ \hline \end{array}$$

$$\begin{array}{r} 4. \quad 2210 \text{ yards} \\ \times 1,10 \text{ cents} \\ \hline \end{array}$$

$$\begin{array}{r} \$2431,00 \\ \hline \end{array}$$

$$\begin{array}{r} \text{Or, } \begin{array}{c|c|c} \text{cts.} & & \\ 10 & \frac{1}{10} & \end{array} \begin{array}{r} 2210 \text{ yards} \\ 221 \\ \hline \end{array} \\ 2431 \text{ dollars} \end{array}$$

$$\begin{array}{r} 5. \quad 2,415 \\ \times 421 \text{ yards} \\ \hline \end{array}$$

$$\begin{array}{r} 2415 \\ \hline \end{array}$$

$$\begin{array}{r} 4830 \\ \hline \end{array}$$

$$\begin{array}{r} 9660 \\ \hline \end{array}$$

$$\begin{array}{r} 1016,715 \\ \hline \end{array}$$

$$\begin{array}{r} \text{Or, } 421 \\ \quad 2 \\ \hline \end{array}$$

$$\begin{array}{r} \begin{array}{c|c|c} \text{cts.} & & \\ 20 & \frac{1}{5} & \\ 20 & \frac{1}{5} & \\ 10 \text{ ms.} & \frac{1}{5} & \\ 5 & \frac{1}{20} & \end{array} \begin{array}{r} 842 \\ 84,2 \\ 84,2 \\ 4,21 \\ 2,105 \\ \hline \end{array} \end{array}$$

$$\begin{array}{r} \text{Or, } 1016 \text{ dolls. } 71 \text{ cts. } 5 \text{ ms.} \\ 1016,715 \end{array}$$

$$\begin{array}{r} 6. \quad 625 \\ \quad 25 \\ \hline \end{array}$$

$$\begin{array}{r} 3125 \\ \hline \end{array}$$

$$\begin{array}{r} 1250 \\ \hline \end{array}$$

$$\begin{array}{r} \$156,25 \\ \hline \end{array}$$

$$\begin{array}{r} \text{Or thus,} \\ \hline \end{array}$$

$$\begin{array}{r} \begin{array}{c|c} \text{cts.} & \\ 26 \text{ is } \frac{1}{4} & \end{array} \begin{array}{r} 625 \\ \hline \end{array} \\ \$156,25 \end{array}$$

$$\begin{array}{r} 7. \quad 8275 \\ \quad 4,4 \text{ ms.} \\ \hline \end{array}$$

$$\begin{array}{r} 33100 \\ \hline \end{array}$$

$$\begin{array}{r} 33100 \\ \hline \end{array}$$

$$\begin{array}{r} 36410,0 \\ \hline \end{array}$$

$$\begin{array}{r} \begin{array}{c|c} \text{cts.} & \\ 4 \text{ is } \frac{1}{25} & \\ 4 \text{ ms. } \frac{1}{10} & \end{array} \begin{array}{r} 8275 \\ 331 \\ 331 \\ \hline \end{array} \\ 364,10 \end{array}$$

$$\begin{array}{r} \text{Or, } 364 \text{ dolls. } 10 \text{ cts.} \end{array}$$

$$\begin{array}{r} 8. \quad 8275 \\ \quad 5 \\ \hline \end{array}$$

$$\begin{array}{r} 41375 \text{ mills.} \\ \hline \end{array}$$

$$\begin{array}{r} \text{Or, } 8275 \\ \hline \end{array}$$

$$\begin{array}{r} 5 \text{ mills is } \frac{1}{200} \quad 41,375 \\ \text{Or, } 41 \text{ dolls. } 37 \text{ cts. } 5 \text{ ms.} \end{array}$$

Case 2. Page 69.

$$\begin{array}{r} \text{cwt.} \quad \text{qr.} \quad \text{lb.} \quad \text{lb.} \\ 2. \quad 4 \quad 1 \quad 14=490 \end{array}$$

$$\frac{1}{4}=122,5 \quad \text{Or, 122 dolls. 50 cts.}$$

$$\begin{array}{r} \text{cwt.} \quad \text{qr.} \quad \text{lb.} \quad \text{lb.} \\ 3. \quad 12 \quad 2 \quad 13=1413 \\ \quad \times 2 \\ \hline 3) 2826 \\ \hline \$942 \end{array}$$

$$\begin{array}{r} \text{cwt.} \quad \text{qr.} \quad \text{lb.} \quad \text{lb.} \\ 4. \quad 14 \quad 2 \quad 7=1631 \\ \quad \times 7 \\ \hline \text{lb.} \\ 5 \times 8=40 \quad 11417 \\ \hline \$285,425 \end{array}$$

*Application.*

Page 70.

*cwt. lb. hhds.*

$$\text{Quest. 1. } 12,5 \times 112 \times 6 \times \frac{3}{8} = 3150 \text{ dollars.}$$

$$\begin{array}{r} 2. \quad 60 \text{ ton} \\ \quad \times 3 \\ \hline \end{array}$$

$$5) 180$$

$$\begin{array}{r} \text{ton Eag.} \quad 36 \\ 60 \times 2 = \quad 120 \end{array}$$

$$156 \text{ Eagles}$$

$$\text{Or, 1560 dolls.}$$

$$\begin{array}{r} 3. \quad 12,650 \text{ feet} \\ \quad \times 10 \\ \hline \end{array}$$

$$126,500$$

$$\frac{4}{9} \text{ is } \frac{1}{2} = 6,325$$

$$\frac{2}{3} \text{ is } \frac{1}{2} = 3,1625$$

$$\frac{1}{8} \text{ is } \frac{1}{2} = 1,58125$$

$$137,56875$$

$$\text{Or, 137 dolls. 56 cts. } 8\frac{3}{4} \text{ ms.}$$

Case 3.

$$\begin{array}{r} \text{dolls.} \quad \text{cts.} \\ 2. \quad 10 \quad 94 \\ \text{Mult. by} \quad 17 \text{ cwt.} \end{array}$$

$$7658$$

$$1094$$

$$2 \text{ qr. is one half} \quad 547$$

$$1 \text{ is one half} \quad 2735$$

$$14 \text{ lb. is one half} \quad 13675$$

$$4 \text{ is one seventh} \quad 3907$$

$$1 \text{ is one fourth} \quad 976$$

$$\$196,0408$$

$$\text{Or, 196 d. 4 cts.}$$

$$\begin{array}{r} \text{dolls.} \quad \text{cts.} \\ 3. \quad 13 \quad 41 \\ \text{Mult. by} \quad 5 \text{ cwt.} \end{array}$$

$$67,05$$

$$1 \text{ qr. is } \frac{1}{4} = 3,352\frac{1}{2}$$

$$70,402\frac{1}{2}$$

$$70 \text{ dolls. 40 cts. } 2\frac{1}{2} \text{ ms.}$$

Page 70.

$$\begin{array}{r}
 \text{dolls. cts. ms.} \\
 4. \quad 15 \quad 00 \quad 5 \\
 \times \quad \quad \quad 7 \\
 \hline
 105,035 \\
 16 \text{ lb. is } \frac{1}{7} = 2,14357+ \\
 2 \text{ lb. is } \frac{1}{8} = ,26794+ \\
 1 \text{ lb. is } \frac{1}{2} = ,13397+ \\
 \hline
 107,58048+ \\
 \hline
 107 \text{ dolls. } 58 \text{ cts. } \&c.
 \end{array}$$

Case 4. Page 71.

$$\begin{array}{rcl}
 \text{s. } d. & \text{s. } d. & \text{Or, 473 yards} \\
 2. \quad 6 \quad 8 \text{ is } \frac{1}{3} ) 473 \text{ yds. at } 6 \quad 8 & & 88\frac{8}{9} \text{ cts.}
 \end{array}$$

$$\underline{\text{£}157 \quad 13 \quad 4}$$

$$\underline{3784}$$

$$3784$$

$$420\frac{4}{9}$$

$$\begin{array}{rcl}
 \text{s. } d. & \text{s. } d. & \\
 3. \quad 3 \quad 4 \text{ is } \frac{1}{6} ) 397 \text{ yds. at } 3 \quad 4 & &
 \end{array}$$

$$\underline{\$420,44\frac{4}{9}}$$

$$\underline{\text{£}66 \quad 3 \quad 4}$$

$$\begin{array}{l}
 \text{Or, 397 yards} \\
 ,44\frac{4}{9} \text{ cts.} = 3\text{s. } 4d.
 \end{array}$$

$$\underline{1588}$$

$$1588$$

$$\frac{4}{9} = 176\frac{4}{9}$$

$$\underline{\$176,44\frac{4}{9}}$$

$$\text{Or, } 159,25$$

$$22\frac{2}{9} \text{ cts.} = 1\text{s. } 8d.$$

$$4. \quad \underline{159\frac{1}{4} \text{ lb. at } 1\text{s. } 8d.}$$

$$\underline{31850}$$

$$1\text{s. } 8d. \text{ is } \frac{1}{12} ) 159 \quad 5 \text{ value at } 1\text{£.}$$

$$31850$$

$$\frac{2}{9} = 3538\frac{8}{9}$$

$$\underline{\text{£}13 \quad 5 \quad 5}$$

$$\underline{\$35,3888\frac{8}{9}}$$

$$\text{Or, } \$35 \quad 38\frac{8}{9}$$

Page 71.

$$\begin{array}{r|l}
 5. & 10s. \text{ is } \frac{1}{2} \\
 & 2 \text{ is } \frac{1}{5} \\
 \hline
 & 658 \text{ at } 12s. \\
 & \underline{\hspace{1cm}} \\
 & 329 \\
 & 65 \quad 16 \\
 & \underline{\hspace{1cm}} \\
 & £394 \quad 16
 \end{array}$$

$$\begin{array}{r}
 \text{Or, } 658lb. \\
 160cts. = 12s. \\
 \hline
 39480 \\
 658 \\
 \hline
 \$1052,80
 \end{array}$$

$$\begin{array}{r|l}
 6. & 10s. \text{ is } \frac{1}{2} \\
 & 5s. \text{ is } \frac{1}{2} \\
 & 1s. \text{ is } \frac{1}{5} \\
 \hline
 & 745 \text{ at } 16s. \\
 & \underline{\hspace{1cm}} \\
 & 372 \quad 10 \\
 & 186 \quad 5 \\
 & 37 \quad 5 \\
 & \underline{\hspace{1cm}} \\
 & £596 \quad 0
 \end{array}$$

$$\begin{array}{r}
 \text{Or, } 745 \text{ yards} \\
 213\frac{1}{3}c. = 16s. \\
 \hline
 2235 \\
 745 \\
 \hline
 1490 \\
 \frac{1}{3} = 248\frac{1}{3} \\
 \hline
 \$1589,33\frac{1}{3}
 \end{array}$$

$$\begin{array}{r|l}
 7. & 10s. \text{ is } \frac{1}{2} \\
 & 5 \text{ ' } \frac{1}{4} \\
 & 4 \text{ ' } \frac{1}{5} \\
 & 8d. \text{ ' } \frac{1}{6} \\
 & 2 \text{ ' } \frac{1}{4} \\
 & 1 \text{ , } \frac{1}{2} \\
 \hline
 & 969 \text{ at } 19s. 11d. \\
 & \underline{\hspace{1cm}} \\
 & 484 \quad 10 \\
 & 242 \quad 5 \\
 & 193 \quad 16 \\
 & 32 \quad 6 \\
 & 8 \quad 1 \quad 6 \\
 & 4 \quad 0 \quad 9 \\
 & \underline{\hspace{1cm}} \\
 & £964 \quad 19 \quad 3
 \end{array}$$

$$\begin{array}{r}
 \text{Or,} \\
 969 \\
 265\frac{5}{9}cts. = 19s. 11d. \\
 \hline
 4845 \\
 5814 \\
 1938 \\
 \frac{5}{9} = 538\frac{1}{3} \\
 \hline
 \$2573,23\frac{1}{3}
 \end{array}$$

$$\begin{array}{r|l}
 8. & 5s. \\
 & 4 \\
 & 4d. \\
 & \frac{1}{2} \\
 \hline
 & \frac{1}{4} \\
 & \frac{1}{5} \\
 & \frac{1}{12} \\
 & \frac{1}{8} \\
 \hline
 & 3715 \text{ at } 9s. 4\frac{1}{2}d. \\
 & \underline{\hspace{1cm}} \\
 & 928 \quad 15 \\
 & 743 \quad 0 \\
 & 61 \quad 18 \quad 4 \\
 & 7 \quad 14 \quad 9\frac{1}{2} \\
 & \underline{\hspace{1cm}} \\
 & £1741 \quad 8 \quad 1\frac{1}{2}
 \end{array}$$

$$\begin{array}{r}
 \text{Or, } 3715 \\
 125c. = 9s. 4\frac{1}{2}d. \\
 \hline
 18575 \\
 7430 \\
 3715 \\
 \hline
 $4643,75
 \end{array}$$

Page 71.

9.		4567 at 19s. 11½d.	Or, 4567
10s.	$\frac{1}{2}$		266 $\frac{1}{9}$ c. = 19s. 11½d.
5	$\frac{1}{4}$	2283 10	
4	$\frac{1}{5}$	1141 15	27402
8d.	$\frac{1}{6}$	913 8	27402
2	$\frac{1}{4}$	152 4 8	9134
1	$\frac{1}{2}$	38 1 2	$\frac{1}{9} = 507\frac{4}{9}$
$\frac{1}{2}$	$\frac{1}{2}$	19 0 7	
		9 10 3½	\$12153,294 $\frac{4}{9}$
		£4557 9 8½	

Case 5. Page 72.

2.	£.	s.	d.	3.	£.	s.	d.
	89	6	8 × 1		8	11	5
			6				9
	536	0	0		77	2	9
			6				8
cwt.	3216	0	0		617	2	0
10 is $\frac{1}{2}$	89	6	8	2 qr. is $\frac{1}{2}$	4	5	8½
4 ' $\frac{1}{5}$	44	13	4	1 ' ' $\frac{1}{5}$	2	2	10¼
2qr. ' $\frac{1}{8}$	17	17	4	16 lb. ' $\frac{1}{7}$	1	4	5¾ +
14lb. ' $\frac{1}{4}$	2	4	8	8 ' ' $\frac{1}{2}$	0	12	2¾ +
	0	11	2	2 ' ' $\frac{3}{4}$	0	3	0½ +
				1 ' ' $\frac{1}{2}$	0	1	6¼
	£3370	13	2		£625	11	10
	£.	s.	d.		A. R. P.		
4.	3	17	6	5.	476	3	28
			12		£	3	7s. 11d.
	46	10	0				
			12	5s. is $\frac{1}{4}$	1428		
	558	0	0	2s. 6d. ' $\frac{1}{2}$	119		
2qr. is $\frac{1}{2}$	1	18	9	5d. ' $\frac{1}{6}$	59	10	
14lb. ' $\frac{1}{4}$	0	9	8¼	2r. is $\frac{1}{2}$	9	18	4
7 ' $\frac{1}{2}$	0	4	10	1 ' ' $\frac{1}{2}$	1	13	11½
				20p. ' $\frac{1}{2}$	0	16	11¾
	£560	13	3¼	8 ' ' $\frac{1}{5}$	8	5¾	+
					3	4¾	
					£1619	11	1¾



Page 72.

6. *d. c.*  
10,55  
640 acres

---

42200  
6330  
2r. is  $\frac{1}{2}$  5275  
20p. is  $\frac{1}{4}$  1318 $\frac{3}{4}$

---

\$6758,593 $\frac{3}{4}$

---

Or, 6758d. 59c. 3 $\frac{3}{4}$ m.

7. *d. c.*  
18,50  
229 acres

---

16650  
370  
390  
2r. is  $\frac{1}{2}$  925  
1 '  $\frac{1}{2}$  4625  
10p. '  $\frac{1}{4}$  1156 $\frac{1}{4}$   
8 '  $\frac{1}{5}$  925

---

\$4252,456 $\frac{1}{4}$

---

Or, 4252d. 45c. 6 $\frac{1}{4}$ m.

8. *d. cts.*  
6,34  
12

---

lb. 7608  
7 is  $\frac{1}{16}$  396 $\frac{1}{4}$

---

\$76,476 $\frac{1}{4}$

---

Or, 76d. 47c. 6 $\frac{1}{4}$ m.

9. *dolls.*  
14  
17 cwt.

---

238  
2qr. is  $\frac{1}{2}$  7  
1 ' '  $\frac{1}{2}$  35  
14lb. '  $\frac{1}{2}$  175  
7 ' '  $\frac{1}{2}$  875  
3 $\frac{1}{2}$  ' '  $\frac{1}{2}$  437 $\frac{1}{2}$

---

\$251,562 $\frac{1}{2}$

---

Or, 251d. 56c. 2 $\frac{1}{2}$ m.

10. *d. c.*  
125,50  
16

---

200800  
2r. is  $\frac{1}{2}$  6275  
1 '  $\frac{1}{2}$  31375  
20per. '  $\frac{1}{2}$  15687 $\frac{1}{2}$   
5 ' '  $\frac{1}{4}$  3921 $\frac{7}{8}$

---

\$2121,734 $\frac{3}{8}$

---

Or, 2121d. 73c. 4m. +

Page 72.

		£.	s.	d.	
11.		3	17	6	
				5	
		<hr/>			
		19	7	6	
				5	
		<hr/>			
		96	17	6	value of 25 cwt.
2qr.	is $\frac{1}{2}$	1	18	9	of 2 qrs.
1	' $\frac{1}{2}$	0	19	$4\frac{1}{2}$	of 1 qr.
14lb.	' $\frac{1}{2}$		9	$8\frac{1}{4}$	of 14 lb.
		<hr/>			
		£100	5	$3\frac{3}{4}$	

## TARE AND TRET.

Page 73.

		cwt.	qr.	lb.	lb.
Quest. 2.	No. 1.	2	1	25	tare 21
	' 2.	2	2	0	' 21
	' 3.	2	0	21	' 21
		<hr/>			
	Gross	7	0	18	tare 63 lb. = 2 qr. 7 lb.
	Tare		2	7	
		<hr/>			
	Neat cwt.	6	2	11	

	d. c.		cwt.	qr.	lb.	lb.
	12,50		3.	16	1	3 = 1823 gross
	6					132 tare
	<hr/>					
2qrs.	is $\frac{1}{2}$	75,00				1691 neat
8lb.	' $\frac{1}{7}$	6,25				Mult. ,45 cts.
2	' $\frac{1}{4}$	892 $\frac{6}{7}$				
1	' $\frac{1}{2}$	223 $\frac{3}{4}$				8455
		111 $\frac{17}{28}$				6764
		<hr/>				
		\$82,477 $\frac{19}{28}$				\$760,95

Page 74.

	<i>cwt.</i>	<i>qr.</i>	<i>lb.</i>	<i>lb.</i>	<i>d. cts.</i>
4. No. 1.	11	1	17	tare 112	16,80
	2.	12	2	0 ' 74	22
<hr/>					<hr/>
Gross	23	3	17	tare 186	33,60
186lb.=	1	2	18		336
<hr/>					<hr/>
	22	0	27	neat	16lb. is $\frac{1}{7}$ 2,40
					8 ' $\frac{1}{2}$ 1,20
					2 ' $\frac{1}{4}$ 30
					1 ' $\frac{1}{2}$ 15
<i>bbls. cts.</i>				<i>d. cts.</i>	<hr/>
18×450	=			81,00	\$373,65 cost
Ton. $1\frac{1}{2}$ ×120d.	=			180,00	261,00 gave
<hr/>					<hr/>
\$261,00 paid.					\$112,65 due

	<i>cwt.</i>	<i>qr.</i>	<i>lb.</i>	<i>dolls.</i>
5.	4	2	26	9
			12	50 cwt.
<hr/>				<hr/>
	56	3	4 gross	450
<hr/>				<hr/>
8lb. is $\frac{1}{14}$	4	0	6+	2qr. is $\frac{1}{2}$ 4,50
4 ' $\frac{1}{2}$	2	0	3+	14 ' $\frac{1}{4}$ 1,12 $\frac{1}{2}$
<hr/>				<hr/>
	6	0	9 tare	7 ' $\frac{1}{2}$ 56 $\frac{1}{4}$
<hr/>				<hr/>
				2 ' $\frac{1}{7}$ 16+
<hr/>				<hr/>
Cwt. 50	2	23	neat	\$456,34 $\frac{3}{4}$

<i>cwt.</i>	<i>lb.</i>	<i>cwt.</i>	<i>qr.</i>	<i>lb.</i>	
6.	6=672 gross	7.	120	3=13524 gross	
	100 tare			177 tare	
<hr/>		<hr/>		<hr/>	
	572			13347	
$\frac{1}{20}$ =	22 tret	$\frac{1}{20}$ =		513,346 tret	
<hr/>		<hr/>		<hr/>	
	lb. 550 neat			12833,654	
<hr/>		<hr/>		<hr/>	
lbs.	cts.	lbs.	cts.		,73 cents
As 550 :	8250 :	1 :	$\frac{8250}{550}$ =15	38500962	
<hr/>				89835578	
<hr/>				9368,56742	
<hr/>				Or, 9368 dolls. 56 cts. 7 ms.	

Page 74.

8.	<i>cwt.</i>	<i>qr.</i>	<i>lb.</i>						
	6	2	12					16	dollars
			9					50	cwt.
<hr/>									
	59	1	24	gross				800	
<hr/>									
16 <i>lb.</i> is $\frac{1}{7}$	8	1	27		1 <i>qr.</i> is $\frac{1}{4}$	4			
1 ' $\frac{1}{16}$		2	3		14 <i>lb.</i> ' $\frac{1}{2}$	2			
					7 ' $\frac{1}{2}$	1			
					1 ' $\frac{1}{7}$	0,14 $\frac{2}{7}$			
<hr/>									
	9	0	2	tare				\$807,14 $\frac{2}{7}$	
<hr/>									
Cwt.	50	1	22	neat					

9.  $\begin{matrix} \text{lb.} & \text{cwt.} & \text{qr.} & \text{lb.} \\ 325 (=2 & 3 & 17) \end{matrix} \times 27 = 8775 \text{ gross}$   
 $8775 \text{ lb.} \times \frac{13}{112} = 1018 \text{ tare}$

---

7757

$7757 \div 26 = 298 \text{ tret}$

---

$7459 \text{ lb.} = 66 \text{ cwt. } 2 \text{ qr. } 11 \text{ lbs.}$

$\begin{matrix} \text{lbs.} & \text{ct.} & \text{dolls.} & \text{cts.} \\ \text{And } 7459 \times 32 = 2386,88 \end{matrix}$

## SIMPLE INTEREST.

Case 1. Page 75.

*dolls. dolls. yr. cts.*

4.  $200 \times 6 \times 2 = 2400 = 24 \text{ dollars}$

Page 76.

*dolls. dolls. yrs. cts. dolls. cts.*

5.  $1260 \times 7 \times 4 = 35280 = 352,80$

*dolls. dolls. yrs. cts. dolls. cts.*

6.  $560 \times 8 \times 3 = 13440 = 134,40$

*d. cts. d. d. cts.*

Now  $134,40 + 560 = 694,40$

*d. d. yrs. cts. d. cts.*

7.  $4520 \times 5 \times 6 = 135600 = 1356,00$

*d. cts. d.*

And  $1356,00 + 4520 = 5876 \text{ dollars.}$

Page 76.

$$8. \quad \begin{array}{ccc} \text{dolls.} & \text{d. yrs.} & \text{cts.} \\ 400 \times 6\frac{1}{2} \times 2 = 5200 = 52 \text{ dolls.} \end{array} \quad \begin{array}{ccc} \text{d.} & \text{d.} & \text{d.} \\ \text{And } 52 + 400 = 452 \end{array}$$

$$9. \quad \begin{array}{ccc} \text{dolls.} & \text{dolls.} & \text{yrs.} & \text{cts.} \\ 4925 \times 7\frac{1}{2} \times 9 = 332437\frac{1}{2} = 3324 \text{ } 37 \text{ } 5 \end{array} \quad \begin{array}{ccc} \text{dolls.} & \text{cts.} & \text{ms.} \end{array}$$

$$10. \quad \begin{array}{ccc} \text{dolls.} & \text{dolls.} & \text{cts.} \\ 2500 \times 7\frac{3}{4} = 19375 = 193 \text{ } 75 \end{array} \quad \begin{array}{ccc} \text{dolls.} & \text{cts.} & \end{array}$$

$$\text{And } \begin{array}{ccc} \text{d.} & \text{c.} & \text{d.} \\ 193 & 75 & + 2500 = 2693 \text{ } 75 \end{array} \quad \begin{array}{ccc} \text{d.} & \text{cts.} & \end{array}$$

Case 2. Page 77.

$$4. \quad \begin{array}{ccc} \text{dolls.} & \text{c.} & \text{ms.} \\ 1260 & 50 & 5 \\ & & 7\frac{1}{2} \end{array}$$

$$\text{Now } \begin{array}{ccc} \text{d.} & \text{cts.} & \text{ms.} \\ 283 & 61 & 3+ \\ 1260 & 50 & 5 \end{array}$$

$$\begin{array}{r} 8823535 \\ 6302525 \\ \hline \end{array}$$

$$\begin{array}{r} \$1544 \text{ } 11 \text{ } 8 \text{ amount} \end{array}$$

$$\text{cents } 9453,7875 \text{ interest for 1 year}$$

$$\begin{array}{r} 28361,3625 \end{array}$$

Or, 283 dolls. 61 cts. 3+ms. interest for three years.

$$5. \quad \begin{array}{cc} \text{dolls.} & \text{cts.} \\ 630 & 50 \\ & 8 \end{array}$$

$$6. \quad \begin{array}{ccc} \text{dollars} & \text{cts.} & \text{d. yrs.} \\ 3462 & 84 & \times 3\frac{1}{4} \times 4 = 450 \end{array} \quad \begin{array}{ccc} \text{d.} & \text{cts.} & \text{ms.} \\ 1692 & \text{int.} & \\ 1274 & 646 \times 7\frac{1}{2} \times 3 = 286 & 79535 \text{ int.} \end{array}$$

$$\begin{array}{r} 50 \text{ } 4400 \text{ int. for 1 year} \\ 5 \end{array}$$

$$\begin{array}{r} 163 \text{ } 37385 \text{ diff.} \end{array}$$

$$\begin{array}{r} 252 \text{ } 20 \text{ int. for 5 years} \end{array}$$

$$\begin{array}{r} 630 \text{ } 50 \text{ principal} \end{array}$$

$$\begin{array}{r} \$882 \text{ } 70 \text{ amount} \end{array}$$

$$\begin{array}{ccc} \text{dolls.} & \text{cts.} & \text{ms.} \\ \text{Or, } 163 & 37 & 3,85 \end{array}$$

$$7. \quad \begin{array}{cc} \text{dolls.} & \text{cts.} \\ 3 ) 3422 & 25 \end{array}$$

$$\begin{array}{ccc} \text{dolls.} & \text{cts.} & \text{ms.} \\ 1140 & 75 \times \frac{6}{100} = 68 & 44 \text{ } 5 \text{ int. for 1 year} \\ 68 & 44 & 5 \text{ interest for one year} \end{array}$$

$$\begin{array}{r} 1209 \text{ } 19 \text{ } 5 \text{ first payment.} \end{array}$$

Question seven continued.

	<i>dolls. cts.</i>		<i>dolls. cts.</i>
<i>d. c. m. yr.</i>	1140 75	<i>d. c. m.</i>	1140 75
$68,44,5 \times 2 =$	136 89	int. for 2 yrs.	$68,44,5 \times 3 =$
			205 335
	<u>\$1277 64</u>	2d payment	3d pay't.
			<u>1346 085</u>
	<i>d. c. ms.</i>		
Now,	1209 19 5	first payment	
	1277 64 0	second	
	1346 08 5	third	
	<u>\$3832 92 0</u>	whole amount	

Case 3. Page 78.

4.	18 months	Then, 724 dollars.
	4 per cent.	6
	<u>12 ) 72</u>	<u>\$43,44</u> interest
		724,00 principal
	6 rate for the time	<u>\$767 44</u> amount.

5.	15 months	<i>d. c. m.</i>
	$7\frac{1}{2}$ per cent.	Then, 9 375
		240 dollars
	<u>12 ) 112<math>\frac{1}{2}</math></u>	<u>375000</u>
	9,375 rate for the time	18750
		<u>22,50000</u>

Or, 22 dollars 50 cents.

6.	4 months	<i>dolls.</i>
	$6\frac{1}{2}$ per cent.	Then, 1260
		$2\frac{1}{6}$
	<u>12 ) 26</u>	<u>2520</u>
	$2\frac{1}{6}$ rate for the time	210
		<u>\$27 30</u> cents.

## Case 4. Page 80.

$$5. \quad \begin{array}{c} \text{dolls.} \quad \text{days} \quad (\text{constant div.}) \quad \text{d.} \quad \text{cts.} \\ (12000 \times 40) \div 5214 = 92 \quad 06 \text{ nearly} \end{array}$$

$$6. \quad \begin{array}{c} \text{dolls.} \quad \text{days} \quad (\text{c. d.}) \quad \text{d.} \quad \text{cts.} \quad \text{ms.} \\ (8400 \times 20) \div 7300 = 23 \quad 01 \quad 3 \end{array}$$

$$7. \quad \begin{array}{c} \text{d.} \quad \text{cts.} \quad \text{days} \quad (\text{c. d.}) \\ (517 \quad 90 \times 84) \div 6083 = 7 \text{ dolls. } 15 \text{ cts. } 1 \text{ m.} \end{array}$$

$$8. \quad \begin{array}{c} \text{d.} \quad \text{cts.} \quad \text{days} \quad (\text{c. d.}) \\ (73 \quad 41 \times 27) \div 60 = 33 \text{ cts.} \end{array}$$

$$9. \quad \begin{array}{c} \text{dolls.} \quad \text{cts.} \quad \text{days} \quad (\text{c. d.}) \quad \text{d.} \quad \text{c.} \quad \text{m.} \\ (225 \quad 24 \times 40) \div 6083 = 1 \quad 48 \quad 1 \end{array}$$

$$10. \quad \begin{array}{c} \text{dolls.} \quad \text{days} \quad (\text{c. d.}) \quad \text{d.} \quad \text{c.} \quad \text{m.} \\ (1200 \times 80) \div 6083 = 15 \quad 78 \quad 1 \end{array}$$

$$11. \quad \begin{array}{c} \text{dollars} \quad \text{cts.} \quad \text{days} \quad (\text{c. d.}) \quad \text{d.} \quad \text{cts.} \quad \text{m.} \\ (2962 \quad 19 \times 254) \div 6083 = 123 \quad 68 \quad 8 \end{array}$$

$$12. \quad \begin{array}{c} \text{d.} \quad \text{cts.} \quad \text{days} \quad (\text{c. d.}) \quad \text{d.} \quad \text{c.} \quad \text{m.} \\ (1733 \quad 97 \times 102) \div 6083 = 29 \quad 07 \quad 5 \end{array}$$

## Case 5. Page 81.

$$2. \quad \begin{array}{c} \text{yrs.} \quad \text{d.} \quad \text{d.} \quad \text{d.} \\ (12 \times 6) + 100 = 172 \quad \text{Then,} \end{array}$$

$$\text{As } 172 : 100 :: 2752 : \frac{2752 \times 100}{172} = 1600$$

$$3. \quad \begin{array}{c} \text{yrs.} \quad \text{d.} \quad \text{d.} \quad \text{d.} \\ (5 \times 6) + 100 = 130 \quad \text{Then,} \end{array}$$

$$\text{As } 130 : 100 :: 728 : \frac{728 \times 100}{130} = 560$$

$$4. \quad \begin{array}{c} \text{yrs.} \quad \text{d.} \quad \text{d.} \quad \text{d.} \\ (4 \times 7\frac{1}{2}) + 100 = 130 \quad \text{Then,} \end{array}$$

$$\text{As } 130 : 100 :: 1638 : \frac{1638 \times 100}{130} = 1260$$

$$5. \quad \begin{array}{c} \text{yrs.} \quad \text{d.} \quad \text{cts.} \quad \text{d.} \quad \text{d.} \quad \text{cts.} \\ (5 \times 5 \quad 75) + 100 = 128 \quad 75 \quad \text{Then,} \end{array}$$

$$\text{As } 128 \quad 75 : 100 :: 2000 : \frac{2000 \times 100}{128,75} = 1553 \quad 39 \quad 8\frac{6}{103}$$

Case 6. Page 82.

$$2. \begin{array}{l} \text{dolls.} \\ 858 \text{ amount} \\ 650 \text{ principal} \\ \hline \end{array} \quad \text{As } \begin{array}{l} \text{dolls.} \\ 650 \end{array} : \begin{array}{l} \text{dolls.} \\ 208 \end{array} :: \begin{array}{l} \text{dolls.} \\ 100 \end{array} : \frac{20800}{650} = 32 \text{ dolls.}$$

Then  $32 \text{ d.} \div 4 \text{ yrs.} = 8 \text{ per cent.}$   
 \$208 interest

$$3. \begin{array}{l} \text{dolls.} \\ 2752 \text{ amount} \\ 1600 \text{ prin.} \\ \hline \end{array} \quad \text{As } \begin{array}{l} \text{dolls.} \\ 1600 \end{array} : \begin{array}{l} \text{dolls.} \\ 1152 \end{array} :: \begin{array}{l} \text{dolls.} \\ 100 \end{array} : \frac{115200}{1600} = 72 \text{ dolls.}$$

\$1152 interest. Then  $72 \text{ dolls.} \div 12 \text{ yrs.} = 6 \text{ dollars}$

$$4. \begin{array}{l} \text{dolls. cts.} \\ 860,80 \text{ amount} \\ 640,00 \text{ prin.} \\ \hline \end{array} \quad \text{As } \begin{array}{l} \text{dolls.} \\ 640 \end{array} : \begin{array}{l} \text{dolls. cts.} \\ 220,80 \end{array} :: \begin{array}{l} \text{dolls.} \\ 100 \end{array} : \frac{22080}{640} = 34\frac{1}{2} \text{ dolls.}$$

\$220,80 interest. Then  $34\frac{1}{2} \text{ d.} \div 6 \text{ yrs.} = 5\frac{3}{4} \text{ per cent.}$

$$5. \begin{array}{l} \text{dolls.} \\ 20100 \text{ amount} \\ 12000 \text{ prin.} \\ \hline \end{array} \quad \text{As } \begin{array}{l} \text{dolls.} \\ 12000 \end{array} : \begin{array}{l} \text{dolls.} \\ 8100 \end{array} :: \begin{array}{l} \text{d.} \\ 100 \end{array} : \frac{810}{12} = 67\frac{1}{2} \text{ dolls.}$$

\$ 8100 interest. Then  $67\frac{1}{2} \text{ d.} \div 15 \text{ yrs.} = 4\frac{1}{2} \text{ per cent.}$

Case 7. Page 83.

$$2. \begin{array}{l} \text{dolls.} \\ 650 \\ 8 \\ \hline \end{array}$$

$$\begin{array}{l} \text{dolls.} \\ 910 \text{ amount} \\ 650 \text{ principal} \\ \hline \end{array}$$

\$52,00 int. for 1 year      \$260 whole interest

$$\text{Then, as } \begin{array}{l} \text{dolls.} \\ 52 \end{array} : \begin{array}{l} \text{year} \\ 1 \end{array} :: \begin{array}{l} \text{dolls.} \\ 260 \end{array} : \frac{260}{52} = 5 \text{ years}$$

$$3. \begin{array}{l} \text{dolls.} \\ 1600 \\ 6 \\ \hline \end{array}$$

$$\begin{array}{l} \text{dolls.} \\ 2080 \text{ amount} \\ 1600 \text{ principal} \\ \hline \end{array}$$

\$96,00 int. for 1 year      \$480 whole interest

$$\text{Then, as } \begin{array}{l} \text{dolls.} \\ 96 \end{array} : \begin{array}{l} \text{year} \\ 1 \end{array} :: \begin{array}{l} \text{dolls.} \\ 480 \end{array} : \frac{480}{96} = 5 \text{ years}$$



Case 8. Page 83.

$$2. \quad 640\text{£ } 3\text{s. } 6\text{d.} = 2845\frac{2}{9} \text{ dollars}$$

5

---


$$\$142,26\frac{1}{3} \text{ interest for 1 year}$$

3

---


$$426,78\frac{1}{3} \text{ interest for 3 years}$$

$$2845,22\frac{2}{9} \text{ principal}$$

---


$$\$3272,00\frac{5}{9} \text{ amount*}$$

	£.	s.	d.	£.	s.	d.	
3.	1374	1	9	77	5	10	in'st. for 1 yr.
rate	per cent.		$5\frac{5}{8}$	38	12	11	for $\frac{1}{2}$ yr.
	6870	8	9	£115	18	9	int. for $1\frac{1}{2}$ yr.
$\frac{4}{8}$ is $\frac{1}{2}$	687	0	$10\frac{1}{2}$				
$\frac{1}{8}$ is $\frac{1}{4}$	171	15	$2\frac{1}{2}$				
	£77,29	4	10				
	20						
	s. 5,84						
	12						
	d. 10,18						

Case 9. Page 85.

2.	1820, January.	Principal	1800 dollars
	<i>dolls.</i>	<i>days</i>	
1821—April 1.	1800	Mult. by 45	equal 819000
	paid 700		
1822—Jan. 1.	1100	Mult.	275 equal 302500
	paid 400		
	700	Mult.	181 equal 126700
July 1, paid 500			
	200	Mult.	184 equal 36800
	214 16 6		
Amount due	\$414 16 6		
			6,0 ) 128500,0
			Interest \$214,166

\* The answer given with the question is obtained by reckoning \$4,44 to be a pound sterling, instead of  $\$4,44\frac{4}{9}$ .

## COMPOUND INTEREST.

Page 87.

$$\begin{array}{l} \text{tabular number} \quad \text{dolls.} \quad \text{d.} \quad \text{cts.} \\ 3. \quad 1,27628 \times 1500 = 1914 \quad 42 \end{array}$$

$$\begin{array}{l} \text{tabular no.} \quad \text{d.} \quad \text{d.} \quad \text{cts.} \quad \text{mi.} \\ 4. \quad 2,54035 \times 4500 = 11431 \quad 57 \quad 5 \quad \text{amount} \\ \quad \quad \quad \text{subtract} \quad 4500 \quad \quad \quad \text{principal} \\ \hline \quad \quad \quad \$6931 \quad 57 \quad 5 \quad \text{interest} \end{array}$$

$$\begin{array}{l} \text{tabular no.} \quad \text{d.} \quad \text{d.} \quad \text{cts.} \\ 5. \quad 3,20713 \times 650 = 2084 \quad 63 \quad 4,5 \text{ mills} \end{array}$$

$$\begin{array}{l} \text{yrs.} \quad \text{yrs.} \\ 6. \quad 21 - 4 = 17 \text{ years, on interest. Then,} \end{array}$$

$$\begin{array}{l} \text{tabular no.} \quad \text{d.} \quad \text{d.} \quad \text{cts.} \\ 2,69277 \times 8000 = 21542 \quad 16 \text{ amount} \end{array}$$

$$\begin{array}{l} \text{d.} \quad \text{cts.} \quad \text{sons} \\ \text{But } 21542 \quad 16 \div 3 = 7180 \text{ dollars } 72 \text{ cents} \end{array}$$

## INSURANCE.

Page 88.

$$\begin{array}{rcl} \begin{array}{l} \text{dolls.} \\ 2. \quad 1650 \\ \quad 15\frac{1}{2} \text{ per cent.} \\ \hline 8250 \\ 1650 \\ 825 \\ \hline \end{array} & & \begin{array}{l} \text{dolls.} \\ 3. \quad 4500 \\ \quad 25 \text{ per cent.} \\ \hline 22500 \\ 90 \\ \hline \end{array} \\ \$255,75 & & \$1125,00 \end{array}$$

$$5. \quad 100 \text{ dollars} - 25 \text{ dollars} = 75 \text{ dollars. Then,}$$

$$\text{As } \begin{array}{l} \text{dolls} \quad \text{dolls.} \quad \text{dolls.} \quad \text{dolls.} \\ 75 : 100 :: 4500 : \frac{450000}{75} = 6000 \end{array}$$

$$6. \quad 100 \text{ dolls.} - 9 \text{ dolls.} = 91 \text{ dolls. Then,}$$

$$\text{As } \begin{array}{l} \text{dolls.} \quad \text{dolls.} \quad \text{dolls.} \quad \text{dolls.} \quad \text{cts.} \\ 91 : 100 :: 560 : \frac{56000}{91} = 615 \quad 38\frac{42}{91} \end{array}$$

## COMMISSION.

Page 38.

<p>2. <i>dolls.</i> 1260 6 per cent. <hr/>\$75,60</p>	<p>3. <i>dolls.</i> 2550 4 per cent. <hr/>\$102,00</p>
---	--

<p>4. <i>dolls.</i> 26342 3 per cent. <hr/>\$790,26</p>	<p>5. <i>dolls.</i> 6422 3 per cent. <hr/>4) 19266 <hr/>\$48,16½</p>
---	--

Page 39.

7. 100 dollars  
3  

---

As 103 : 100 :: *dolls.* 41200 : *dolls.*  $\frac{412000}{103} = 4000$  dolls.

Then, as *dolls. bar.* 8 : 1 :: *dollars* 4000 :  $\frac{4000}{8} = 500$  barrels

## BROKAGE.

<p>2. <i>d. cts.</i> 1625,50 3½ per cent. <hr/>4876,50 541,83½ <hr/>541,833½</p>	<p>3. <i>dolls.</i> 1868 2½ per cent. <hr/>3736 934 <hr/>\$46,70</p>
--	--

Or, 54 dolls. 18½ cts.

4. 560 dollars  
6 per cent.  

---

\$33,60 cents.

## BUYING AND SELLING STOCKS.

Page 90.

<i>dolls.</i>	<i>dolls.</i>	<i>dolls.</i>
2. 1500	Or, 1500	3. 1686
110 per ct.	$\frac{1}{10} = 150$	$\times 128$ per cent.
<hr/>	<hr/>	<hr/>
\$1650,00	\$1650	13488

<i>dolls.</i>	
4. 25000	
108 per cent.	
<hr/>	
\$27000	

<hr/>
1686
<hr/>
\$2158,08

<i>d.</i>	<i>d.</i>	<i>d.</i>
5. 1260	6. 9254	7. 1518
90 per cent.	84 per cent.	$83\frac{3}{4}$ per cent.
<hr/>	<hr/>	<hr/>
\$1134	\$7773,36	\$1271,32 $\frac{1}{2}$

## REBATE OR DISCOUNT.

Page 91.

<i>mo.</i>	<i>d.</i>	<i>mo.</i>	<i>d.</i>	
2. As 12	: 8	:: 18	: 12	int. for the time. Then,
<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	
As 112	: 100	:: 2464	: 2200	Because $\frac{2464 \times 100}{112} = 2200$ <i>dolls.</i>

<i>mo.</i>	<i>d.</i>	<i>mo.</i>	<i>d.</i>	
3. As 12	: $5\frac{1}{2}$	:: 8	: $3\frac{2}{3}$	interest for the time

<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>cts.</i>	<i>d.</i>	<i>cts.</i>
Then, as $103\frac{2}{3}$	: 100	:: 1857	50	: 1791	$80\frac{20}{311}$

For $\frac{185750 \times 100 \times 3}{103\frac{2}{3} \times 3}$	$= 1791$	$80\frac{20}{311}$	<i>dolls. cts.</i>
--	----------	--------------------	--------------------

4.  $(7 \times 2) + 100 = 114$  dollars

<i>dolls.</i>	<i>dolls.</i>	<i>dolls.</i>	
Then, as 114	: 14	:: 650	: $\frac{650 \times 14}{114} = 79$ $82\frac{26}{57}$ <i>dolls. cts.</i>

Page 91.

$$5. \quad \begin{array}{cccc} \text{mo.} & \text{mo.} & \text{d.} & \text{d.} \\ \text{As } 12 & : 4\frac{1}{2} & : : 8 & : 3 = \text{a rate for the time} \end{array}$$

$$\text{Then, as } \begin{array}{cccc} \text{dolls.} & \text{dolls.} & \text{dolls.} & \\ 103 & : 100 & : : 5150 & : \frac{5150 \times 100}{103} = 5000 \text{ p. w.} \end{array}$$

Again,

$$\text{As } \begin{array}{cccc} & & \text{dolls.} & \text{dolls.} \\ 100 & : 99 (=100-1) & : : 5000 & : 4950 \end{array}$$

Page 92. Note 1st.

$$3. \quad \begin{array}{cccc} \text{mo.} & \text{mo.} & \text{dolls.} & \text{dolls.} \\ \text{As } 12 & : 18 & : : 8 & : 12 \text{ rate for the time} \end{array}$$

$$\text{Then, as } \begin{array}{cccc} \text{dolls.} & \text{dolls.} & \text{dolls.} & \text{dolls.} \\ 112 & : 12 & : : 7280 & : 780 \text{ the discount} \end{array}$$

$$\text{Again, } \begin{array}{cccc} \text{dolls.} & \text{mo.} & \text{cents.} & \\ 7280 \times 9 = 65520 & \text{interest at 6 per cent.} & & \\ \frac{1}{3} = 21840 & \text{interest at 2} & \text{' ' '} & \end{array}$$

$$\text{-----}$$

$$\$873,60 \text{ interest at 8 per cent.}$$

$$\text{Subtract } \$780,00 \text{ discount}$$

$$\text{Difference } \$ 93,60$$

Note 2d.

$$2. \quad \begin{array}{cc} \text{dolls.} & \text{cts.} \\ 1650 \times 3 = 4950 = 49 \text{ dollars } 50 \text{ cents.} \end{array}$$

$$3. \quad 2464 \text{ dollars} \times 8 = 19712 \text{ cents discount}$$

$$\text{But } 2464 \text{ dollars} - 19712 \text{ cents} = 2266 \text{ dollars } 88 \text{ cents}$$

**BANK DISCOUNT.**

Page 93.

$$2. \quad \begin{array}{cc} \text{days} & \text{dolls.} \\ \frac{(30+4) \times 250}{60} = 1 \text{ dollar } 41\frac{2}{3} \text{ cents} \end{array}$$

$$\text{Or, } \frac{17 \times 250}{30} = 1 \text{ dollar } 41\frac{2}{3} \text{ cents}$$

$$3. \quad \begin{array}{cc} \text{days} & \text{dolls.} \\ \frac{(90+4) \times 600}{60} = 9 \text{ dollars } 40 \text{ cents} \end{array}$$

$$\text{Or, } \frac{47 \text{ days} \times 600 \text{ dolls.}}{30} = 9 \text{ dollars } 40 \text{ cents}$$

Page 93.

$$4. \quad \frac{\overset{\text{days}}{(60+4)} \times \overset{\text{dolls. cts.}}{1260 \ 40}}{60} = 13 \text{ dollars } 44\frac{32}{75} \text{ cents.}$$

$$\text{Or, } \frac{32 \times 1260 \ 40}{30} = 13 \text{ dollars } 44\frac{32}{75} \text{ cents.}$$

$$5. \quad \frac{\overset{\text{days}}{(60+4)} \times \overset{\text{dolls. cts.}}{2649 \ 75}}{60} = 28 \text{ dollars } 26 \text{ cents } 4 \text{ mills}$$

$$\text{Or, } \frac{32 \times 2649 \ 75}{30} = 28 \text{ dollars } 26 \text{ cents } 4 \text{ mills}$$

## EQUATION OF PAYMENTS.

Page 94.

$$2. \quad \begin{array}{l} \overset{\text{dolls. mo.}}{500 \times 2 = 1000} \\ 1000 \times 5 = 5000 \\ 1500 \times 8 = 12000 \end{array}$$

$$3. \quad \begin{array}{l} \overset{\text{dolls. mo.}}{200 \times 5 = 1000} \\ 300 \times 8 = 2400 \\ 500 \times 10 = 5000 \end{array}$$

$$\begin{array}{r} \hline 3000 \ ) \quad 18000 \quad (6 \text{ mo.} \\ \hline 18000 \end{array} \quad \begin{array}{r} \hline 1000 \ ) \quad 8400 \quad (8 \ 12 \text{ mo. da.} \\ \hline 8400 \end{array}$$

$$4. \quad 1400 \text{ dollars} - 1000 \text{ dollars} = 400 \text{ dollars}$$

$$\text{Then, as } \overset{d.}{400} : \overset{d.}{1000} :: \overset{mo.}{1} : 2\frac{1}{2} \text{ months}$$

## SINGLE FELLOWSHIP.

Page 95.

$$2. \quad \overset{d.}{A \ 7500} + \overset{d.}{B \ 6000} + \overset{d.}{C \ 4500} = \overset{d.}{18000}, \text{ Then,}$$

$$\text{As } \overset{\text{dolls.}}{18000} : \overset{\text{dolls.}}{5400} \text{ or } 10 : 3 :: \left\{ \begin{array}{l} \overset{\text{dolls.}}{7500} : \overset{\text{dolls.}}{2250} \text{ A's gain} \\ 6000 : 1800 \text{ B's ' } \\ 4500 : 1350 \text{ C's ' } \end{array} \right\}$$

$$3. \quad \overset{d. \ cts.}{A \ 1291 \ 23} + \overset{d. \ cts.}{B \ 500 \ 37} + \overset{d. \ cts.}{C \ 709 \ 40} + 228 = \overset{d.}{2729}$$

$$\text{Now, as } \overset{d.}{2729} : \overset{d. \ cts.}{2046 \ 75} :: \overset{d.}{100} : \overset{d.}{75}$$

$$\text{Then, as } 100 : 75 :: \left\{ \begin{array}{l} \overset{d. \ cts.}{1291 \ 23} : \overset{d. \ cts.}{963 \ 42\frac{1}{4}} \\ 500 \ 37 : 375 \ 27\frac{3}{4} \\ 709 \ 40 : 532 \ 05 \\ 228 \ 00 : 171 \end{array} \right\}$$

$$\text{Or, } 4 : 3 ::$$

Page 95.

$$\begin{array}{rcl}
 & \text{dolls.} & A. R. P. \\
 4. \text{ As } 600 : 585 & 2 & 34 :: \left\{ \begin{array}{l} \text{dolls.} \quad A. R. P. \\ 180 : 175 \quad 2 \quad 34\frac{1}{5} \\ 195 : 190 \quad 1 \quad 17\frac{1}{20} \\ 225 : 219 \quad 2 \quad 22\frac{3}{4} \end{array} \right\}
 \end{array}$$

Page 96.

$$\begin{array}{rcl}
 & \text{bbl.} & \text{bbl.} \\
 5. \text{ As } 2160 : 900 & \therefore 12 : 5 :: \left\{ \begin{array}{l} \text{barrels.} \\ 960 : 400 \\ 720 : 300 \\ 480 : 200 \end{array} \right\}
 \end{array}$$

$$\begin{array}{rcl}
 & \text{dolls.} & d. & d. \\
 6. \text{ A } 1260 + \text{B } 840 & = & 2100, & \text{And } 825 - 275 = 550
 \end{array}$$

$$\begin{array}{rcl}
 & d. & d. \\
 \text{Now, as } 2100 : 550 & :: \left\{ \begin{array}{l} d. \quad d. \\ 1260 : 330 \text{ A's gain} \\ 840 : 220 \text{ B's} \end{array} \right\}
 \end{array}$$

$$\begin{array}{rcl}
 & \text{B's gain.} & \text{B's stock.} \\
 \text{And, as } 220 : 840 & \therefore 11 : 42 :: \left\{ \begin{array}{l} d. \quad d. \\ 275 : 1050 \text{ C's stock.} \end{array} \right.
 \end{array}$$

$$\begin{array}{rcl}
 & \text{dolls.} & \text{dolls.} \quad \text{dolls.} \\
 7. \quad (800 \times 2) + 40 & = & 1640 \text{ whole gain, And}
 \end{array}$$

$$\begin{array}{rcl}
 & d. & d. & d. & d. \\
 \text{A's } 140 + \text{B's } 260 + \text{C's } 300 & = & 700
 \end{array}$$

Then, 800 dollars—700 dollars=100 dollars D's stock.

$$\begin{array}{rcl}
 & \text{dolls.} & \text{dolls.} \\
 \text{Now, as } 800 : 1640 & \therefore 20 : 41 :: \left\{ \begin{array}{l} \text{dolls.} \quad \text{dolls.} \\ 140 : 287 \text{ A's gain} \\ 260 : 533 \text{ B's} \\ 300 : 615 \text{ C's} \\ 100 : 205 \text{ D's} \end{array} \right\}
 \end{array}$$

$$\begin{array}{rcl}
 & d. & \text{cts.} \\
 8. \quad \text{cattle dolls.} & & \\
 \text{As } 300 : 96 & \therefore 25 : 8 :: \left\{ \begin{array}{l} 80 : 25 \quad 60 \text{ A pays} \\ 100 : 32 \quad 00 \text{ B} \\ 120 : 38 \quad 40 \text{ C} \end{array} \right\}
 \end{array}$$

9. First  $2+3+5=10$  dollars, Then

$$\begin{array}{rcl}
 & \text{dolls.} & \text{dolls.} \\
 \text{As } 10 : 5000 & \therefore 1 : 500 :: \left\{ \begin{array}{l} \text{dolls.} \\ 2 : 1000 \text{ A gets} \\ 3 : 1500 \text{ B} \\ 5 : 2500 \text{ C} \end{array} \right\}
 \end{array}$$





Page 98.

$$\begin{array}{rcl}
 6. \quad 5 \text{ oxen} \times 4\frac{1}{2} \text{ months} & = & 22\frac{1}{2} \\
 8 \quad \times 5 & = & 40 \\
 9 \quad \times 6\frac{1}{2} & = & 58\frac{1}{2} \\
 \hline
 \end{array}$$

Sum 121

$$\begin{array}{rcl}
 & d. \text{ cts.} & \\
 \text{Now, as } 121 : 145 \text{ } 20 :: & \left\{ \begin{array}{l} 22\frac{1}{2} : 27 \text{ A pays} \\ 40 : 48 \text{ B ' } \\ 58\frac{1}{2} : 70 \text{ } 20 \text{ C ' } \end{array} \right. & 
 \end{array}$$

$$\begin{array}{rcl}
 7. \quad 4000 \text{ dollars} \times 12 \text{ months} & = & 48000 \\
 3000 \text{ ' } \times 15 & = & 45000 \\
 5000 \text{ ' } \times 8 & = & 40000 \\
 \hline
 \end{array}$$

133000

$$\begin{array}{rcl}
 & d. & \\
 \text{As } 133000 : 665 :: & \left\{ \begin{array}{l} 48000 : 240 \text{ dolls. A's part} \\ 45000 : 225 \text{ ' B's ' } \\ 40000 : 200 \text{ ' C's ' } \end{array} \right. & \\
 \text{Or } 200 : 1 & & 
 \end{array}$$

$$\begin{array}{rcl}
 8. \quad 580 \text{ dollars} \times 6\frac{1}{2} \text{ months} & = & 3770 \\
 580 \text{ ' } \times 9\frac{1}{2} & = & 5510 \\
 870 \text{ ' } \times 8\frac{2}{3} & = & 7540 \\
 \hline
 \end{array}$$

16820

$$\begin{array}{rcl}
 & d. \text{ cts.} & \\
 \text{As } 16820 : 263 \text{ } 90 :: & \left\{ \begin{array}{l} 3770 : 59d. \text{ } 15c. \text{ A lost} \\ 5510 : 86 \text{ } 45 \text{ B ' } \\ 7540 : 118 \text{ } 30 \text{ C ' } \end{array} \right. & 
 \end{array}$$

PROFIT AND LOSS.

Page 99.

$$\begin{array}{rcl}
 2. \quad 150 \text{ cents, sold for} & & \\
 120 \text{ cents, cost} & & \\
 \hline
 \end{array}$$

30 cents, gain on 120 cents

$$\begin{array}{rcl}
 & cts. & cts. & d. & d. \\
 \text{Then, as } 120 : 30 :: & 100 : 25 \text{ per cent.} & & & 
 \end{array}$$

$$\begin{array}{rcl}
 & yd. & cts. & yds. & d. & cts. \\
 3. \quad \text{As } 1 : 66 :: 42 : 27 \text{ } 72 \text{ sold for} & & & & & \\
 \text{Subtract } 21 \text{ } 00 \text{ cost} & & & & & \\
 \hline
 \end{array}$$

Rem. \$ 6 72 gain

Page 99.

4. 32 galls.  $\times$  6 barrels = 192 gallons, bought  
 Subtract 12 gallons leaked out

Rem. 180 gallons

And 96 dollars + 12 dollars = 108 dollars sold for

*galls. d. gal. cts.*  
 Then, as 192 : 96 :: 1 : 50 cost per gallon

*g. d. g. cts.*  
 And, as 180 : 108 :: 1 : 60 sold for per gallon

5. 20 cents—17 cents = 3 cents, loss on each knife

*knife cts. knives doz. d. cts.*  
 As 1 : 3 :: 1440 (=120) : 43 20

Page 100.

6. 149 dollars  
 51 "

7. 100 dollars  
 18 "

*yds. — yd. d. d. — cts. d. c. ms.*  
 As 100 : \$200 :: 1 : 2      As 100 : \$82 :: 125 : 1 02 5

- d. d. cts.*  
 8. As 100 : 120 :: 90 : 1 08 must sell for  
 108 cts.—90 cts. = 18 cts. gain per hat

*hat cts. hats doz. d. cts.*  
 Now, as 1 : 18 :: 240 (=20) : 43 20

9. 115 gallons  $\times$  110 cents = 126 50 cost  
 Add 5 00

\$131 50 must sell for

But, as 1 doll. : 1 gall. :: 131 dolls. 50 cts. : 131½ galls.  
 the number of gallons that must be sold. Consequently 131½  
 gallons—115 gallons = 16½ gallons of water.

- dolls. cts.*  
 10. *lb. cwt. cts.* 134 40 cost  
 448 (=4)  $\times$  25 = 112 00 sold for

\$22 40 whole loss

*lb. dolls. cts. lb.*  
 Then, as 448 : 22 40 :: 1 : 5 cents per lb.

Page 100.

11. As 120 : 100 :: <sup>dolls.</sup> 1728 : <sup>dolls.</sup> 1440 whole cost

'Then, as <sup>yards</sup> 360 : <sup>dolls.</sup> 1440 :: <sup>yd.</sup> 1 : 4 dollars

12. \$4 90—\$4=90 cents. Then,

<sup>dolls. cts.</sup> As 4 : 90 :: <sup>dolls.</sup> 1000 : <sup>dolls.</sup> 225

13. As <sup>d.</sup> 120 : <sup>d. cts.</sup> 1 :: 150 : 1 25 per bushel

Now, as <sup>d. cts. bu.</sup> 1 25 : 1 :: <sup>d. cts.</sup> 37 50 : 30 bushels

14. 5000 galls. at 48 cents = 2400 dollars

Interest for 2 months = 32

Costs \$2432 to pay cash  
5000 galls. at 50 cents = \$2500 in two months

Diff. \$ 68 gained by borrowing  
the money and paying the cash..

<sup>head</sup> <sup>dolls.</sup> <sup>dolls.</sup>

15. 12) 240 ( 20 the cost per head

<sup>cts. lb.</sup> Then, as 4 : 1 :: <sup>dolls. lb.</sup> 20 : 500 = <sup>C. gr. lb.</sup> 4 1.24

## BARTER.

Page 101.

2. 320 bushels × \$1 20 = \$384

Subtract 160 cash

\$224

<sup>cts. lb.</sup> Then, as 20 : 1 :: 224 dollars : 1120 lb.

3. As <sup>cts.</sup> 70 : <sup>cts.</sup> 125 :: <sup>bu.</sup> 28 : 50 bushels

4. As 250 : 319 :: <sup>cts.</sup> 23  $\frac{1}{2}$  : <sup>cts. m.</sup> 29 <sup>cts.</sup> 9  $\frac{43}{50}$ , or 30 nearly

5. As 100 : 120 :: <sup>d. cts.</sup> 1 25 : <sup>d. cts.</sup> 1 50

Page 102.

$$6. \quad \begin{array}{ccccccc} & d. & cts. & & d. & cts. & \\ \text{As} & 2 & 50 & : & 2 & 80 & : : 1 \quad 20 : \frac{2,80 \times 1,20}{2,50} = 1 \quad 34 \quad 4 \end{array}$$

$$7. \quad \begin{array}{ccccccc} & cts. & & cts. & & bu. & \\ \text{As} & 99 & : & 90 & : : & 240 & : 218 \frac{2}{11} \text{ bushels} \end{array}$$

$$\text{And, as } \begin{array}{ccccccc} & cts. & & cts. & & cts. & d. \quad cts. \\ & 90 & : & 95 & : : & 99 & : 1 \quad 04 \quad 5 \text{ mills} \end{array}$$

$$8. \quad \begin{array}{ccccccc} & oz. & & d. \quad cts. & & oz. & lb. \quad oz. \\ \text{As} & 16 & : & 1 \quad 28 & : : & 420 (=26 \quad 4) & : 33 \text{ dolls. } 60 \text{ cts.} \end{array}$$

$$\text{Then, as } \begin{array}{ccccccc} & cts. & lb. & & d. \quad cts. & & lb. \\ & 6 & : & 1 & : : & 33 \quad 60 & : 560 = 5 \text{ cwt.} \end{array}$$

$$9. \quad \begin{array}{ccccccc} & cts. & & cts. & & & \\ \text{As} & 22 & : & 3 (=25-22) & : : & 100 & : 13 \frac{7}{11} \end{array}$$

$$\text{And } 13 \frac{7}{11} + 10 = 23 \frac{7}{11}$$

$$\text{Then, as } 100 : 123 \frac{7}{11} : : 28 : 34 \frac{3}{5} \text{ cents}$$

$$10. \quad 250 \text{ barrels} \times 6 \text{ dolls. } 25 \text{ cts.} = 1562 \text{ dolls. } 50 \text{ cts.}$$

$$\begin{array}{ccccccc} & lb. & & cwt. & & cts. & dolls. \quad cts. \\ \text{And } 448 (=4) \text{ at } 30 & = & 134 & 40 \end{array}$$

$$64 \text{ lb. at } \$1 \quad 75 = 112 \quad 00$$

$$25 \text{ y. at } \$6 \quad = 150 \quad 00$$

$$\text{Cash } 206 \quad 10$$

---


$$\$602 \quad 50$$

$$\begin{array}{ccccccc} & dolls. & cts. & & dolls. & cts. & dolls. \\ \text{But } 1562 \quad 50 - 602 \quad 50 & = & 960 & \text{Then, as } 8 & : & 1 & : : 960 : 120 \end{array}$$

## EXCHANGE.

Case 1. Page 104.

$$2. \quad \begin{array}{ccccccc} & d. & & s. & & d. & s. \quad d. \quad \text{£.} \quad \text{£.} \\ \text{As} & 96 (=8) & : & 90 (=7 \quad 6) & : : & 256 & : 240 \end{array}$$

$$\text{Or, } \text{£}256$$

$$\frac{1}{16} = 16 \text{ subtract}$$

---


$$\$240$$

Page 104.

$$3. \quad \begin{array}{ccccccc} d. & s. & d. & d. & s. & d. & L. & L. & s. & d. \\ \text{As } 90 (=7 \ 6) : 56 (=4 \ 8) :: 1500 : 933 \ 6 \ 8 \end{array}$$

Or,  $\frac{\text{£}1500 \times 3\frac{1}{9}}{5} = 933 \ 6 \ 8$  Answer as before

$$4. \quad \begin{array}{ccccccc} s. & s. & \text{£.} & \text{£.} & & & \\ \text{As } 6 : 8 :: 180 : 240 \end{array} \quad \text{Or,} \quad \begin{array}{r} \text{£}180 \\ \frac{1}{3} = 60 \\ \hline \text{£}240 \text{ as before} \end{array}$$

$$5. \quad \begin{array}{ccccccc} d. & s. & d. & s. & \text{£.} & \text{£.} & \\ \text{As } 56 (=4 \ 8) : 72 (=6) :: 280 : 360 \end{array}$$

Or,  $\text{£}280$   
 $\frac{2}{7} = 80$  add  
 $\hline \text{£}360$  as before

$$6. \quad \begin{array}{ccccccc} d. & s. & d. & s. & \text{£.} & \text{£.} & s. & d. \\ \text{As } 72 (=6) : 56 (=4 \ 8) :: 304 : 236 \ 8 \ 10\frac{2}{3} \end{array}$$

Or,  $304$   
 $\frac{1}{9} = 33 \ 15 \ 6\frac{2}{3}$   
 $\hline 270 \ 4 \ 5\frac{1}{3}$   
 $\hline 33 \ 15 \ 6\frac{2}{3}$   
 $\hline \text{£}236 \ 8 \ 10\frac{2}{3}$

Case 2. Page 105.

$$4. \quad \begin{array}{ccccccc} \text{£.} & s. & d. & \text{shillings} & & s. & s. & \text{dolls.} & \text{cts.} \\ 468 \ 19 \ 6 = 9379,5 & & \text{Then, } 9379,5 \div 6 = 1563 \ 25 \end{array}$$

$$5. \quad \begin{array}{ccccccc} \text{£.} & s. & \text{pence.} & & d. & d. & \text{dolls.} & \text{cts.} \\ 750 \ 10 = 180120 & & \text{Then, } 180120 \div 90 = 2001 \ 33\frac{1}{3} \end{array}$$

Case 3. Page 108.

$$5. \quad \begin{array}{ccccccc} \text{£.} & s. & \text{£.} & & & & \\ 540 \ 15 = 540,75 & & \text{Then,} & & & & \\ \text{£}540,75 \times \$4,10 = \$2217 \ 07\frac{1}{2} \end{array}$$

$$6. \quad \frac{2217 \text{ dolls. } 07 \text{ cts. } 5 \text{ ms.}}{4 \text{ dolls. } 10 \text{ cts.}} = 540,75 = 540 \ 15$$

Page 108.

$$\begin{array}{r}
 \text{£. } d. \text{ cts. } d. \text{ cts.} \\
 7. \quad 320 \times 4 \quad 44 = 1420 \quad 80 \text{ at par} \\
 \quad \quad 12\frac{1}{2} \text{ is } \frac{1}{8} = 177 \quad 60 \text{ add} \\
 \hline
 \quad \quad \quad \$1598 \quad 40
 \end{array}$$

Page 109.

$$8. \quad \$3259 \div \$4 \quad 10 = \text{£}794,878. \quad \text{Then,}$$

$$\begin{array}{c}
 \text{£.} \qquad \qquad \text{£} \qquad \qquad \text{£.} \\
 \text{As } 108 : 100 :: 794,878 : 735,9999, \text{ or } 736 \text{ nearly}
 \end{array}$$

Otherwise,

$$\begin{array}{r}
 \$3259 \times 100 \\
 \hline
 \$4,10 \times 108 = 735\frac{1105}{1107} = 735 \quad 19 \quad 11\frac{1}{2} \quad \frac{98}{369}, \text{ or } 736 \text{ nearly.}
 \end{array}$$

## ALLIGATION.

Case 1.

$$\begin{array}{r}
 2. \quad 20 \text{ lbs. at } 10 \text{ cents} = 200 \\
 \quad 30 \quad \text{" at } 15 \quad \text{"} = 450 \\
 \quad 40 \quad \text{" at } 25 \quad \text{"} = 1000 \\
 \hline
 \quad 90 \qquad \qquad \text{cts. } 1650
 \end{array}$$

$$\begin{array}{c}
 \text{lb.} \quad \text{cts.} \quad \text{lb.} \quad \text{cts.} \\
 \text{Now, as } 90 : 1650 :: 1 : 18\frac{1}{3}
 \end{array}$$

$$\begin{array}{r}
 3. \quad 10 \text{ bushels at } 150 \text{ cents} = 1500 \\
 \quad 20 \quad \text{" at } 160 \quad \text{"} = 3200 \\
 \quad 30 \quad \text{" at } 170 \quad \text{"} = 5100 \\
 \hline
 \quad 60 \qquad \qquad \text{9800}
 \end{array}$$

$$\begin{array}{c}
 \text{bu.} \quad \text{cts.} \quad \text{bu.} \quad \text{cts.} \\
 \text{Now, as } 60 : 9800 :: 1 : 163\frac{1}{3}
 \end{array}$$

Page 110.

$$\begin{array}{r}
 4. \quad 4 \text{ ounces at } 75 \text{ cents} = 300 \\
 \quad 8 \quad \text{" at } 60 \quad \text{"} = 480 \\
 \hline
 \quad 12 \qquad \qquad \text{780}
 \end{array}$$

$$\begin{array}{c}
 \text{oz.} \quad \text{cts.} \quad \text{oz.} \quad \text{cts.} \\
 \text{Now, as } 12 : 780 :: 1 : 65
 \end{array}$$

Case 2. Page 110.

$$2. \quad 4 \left\{ \begin{array}{l} 3 \\ 5 \\ 6 \end{array} \right\} \begin{array}{l} 1+2=3 \text{ gallons at 3 dollars} \\ 1 = 1 \quad \text{' at 5 ' } \\ 1 = 1 \quad \text{' at 6 ' } \end{array}$$

$$3. \quad 25 \left\{ \begin{array}{l} 40 \\ 30 \\ 20 \end{array} \right\} \begin{array}{l} 5 \text{ Or, } 1 \\ 5 \text{ Or, } 1 \\ 15+5=20 \end{array} \left| \begin{array}{l} 4 \\ 1 \\ 24 \end{array} \right| \begin{array}{l} 6 \text{ bushels of rye} \\ 6 \text{ ' of corn} \\ 24 \text{ ' of oats} \end{array}$$

$$4. \quad \begin{array}{l} 1st. \\ 100 \end{array} \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 20 \text{ at } 120 \\ 10 \text{ } 110 \\ 10 \text{ } 90 \\ 20 \text{ } 80 \end{array} \left| \begin{array}{l} 2d. \\ 100 \end{array} \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10+20=30 \text{ at } 120 \\ =20 \text{ } 110 \\ =20 \text{ } 90 \\ 20+10=30 \text{ } 80 \end{array} \right.$$

$$3d. \quad \begin{array}{l} 100 \end{array} \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10 \text{ at } 120 \\ 20 \text{ } 110 \\ 20 \text{ } 90 \\ 10 \text{ } 80 \end{array} \left| \begin{array}{l} 4th. \\ 100 \end{array} \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} =10 \text{ at } 120 \\ 10+20=30 \text{ } 110 \\ 20+10=30 \text{ } 90 \\ =10 \text{ } 80 \end{array} \right.$$

$$5th. \quad \begin{array}{l} 100 \end{array} \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10+20=30 \text{ at } 120 \text{ cents} \\ =10 \text{ } 110 \\ 20+10=30 \text{ } 90 \\ =20 \text{ } 80 \end{array}$$

$$6th. \quad \begin{array}{l} 100 \end{array} \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} =20 \text{ at } 120 \text{ cents} \\ 10+20=30 \text{ } 110 \\ =10 \text{ } 90 \\ 20+10=30 \text{ } 80 \end{array}$$

$$7th. \quad \begin{array}{l} 100 \end{array} \left\{ \begin{array}{l} 120 \\ 110 \\ 90 \\ 80 \end{array} \right\} \begin{array}{l} 10+20=30 \text{ at } 120 \text{ cents} \\ 10+20=30 \text{ } 110 \\ 20+10=30 \text{ } 90 \\ 20+10=30 \text{ } 80 \end{array}$$

Case 3. Page 112.

$$2. \quad 22 \left\{ \begin{array}{l} 48 \\ 36 \\ 30 \\ 18 \end{array} \right\} \begin{array}{l} = 4 \\ = 4 \\ = 4 \\ 26+14+8=48 \text{ given,} \end{array}$$

Now, as  $48 : 24bu. :: 4 : 2$  bushels of each sort.





Page 114.

4.  $4800 \overline{) 10800} (2 \quad \text{Then, } 1200 \overline{) \frac{4800}{10800}} (= \frac{4}{9}$   
 $\quad \quad \quad 9600$   


---

 com. measure  $1200 \overline{) 4800} (4 \quad \text{Or, } \frac{(12)}{108 \overline{) 00}} = \frac{4}{9} \text{ as before}$   
 $\quad \quad \quad 4800$
5.  $91 \overline{) 117} (1 \quad \text{Then, } 13 \overline{) \frac{91}{117}} (= \frac{7}{9}$   
 $\quad \quad \quad 91$   


---

 $26 \overline{) 91} (3$   
 $\quad \quad \quad 78$   


---

 com. measure  $13 \overline{) 26} (2$   
 $\quad \quad \quad 26$
6.  $9876 \overline{) 88884} (9 \quad \text{Therefore, } 9876 \overline{) \frac{9876}{88884}} (= \frac{1}{9}$   
 $\quad \quad \quad 88884$

Case 2. Page 115.

2.  $\frac{12 \times 17 + 15}{17} = \frac{219}{17}$  fraction required
3.  $\frac{183 \times 21 + 5}{21} = \frac{3848}{21}$  fraction required
4.  $\frac{514 \times 16 + 5}{16} = \frac{8229}{16}$  fraction required
5.  $\frac{68425 \times 4 + 3}{4} = \frac{273703}{4}$  fraction required

Case 3.

2.  $3848 \div 21 = 183 \frac{5}{21}$  equivalent mixed number
3.  $2465 \div 7 = 352 \frac{1}{7}$  equivalent mixed number
4.  $961 \div 17 = 56 \frac{9}{17}$  equivalent mixed number
5.  $8229 \div 16 = 514 \frac{5}{16}$  equivalent mixed number

Case 4. Page 116.

2.  $3 \times 5 \times 6 = 90$  first numerator  
 $4 \times 4 \times 6 = 96$  second numerator  
 $5 \times 4 \times 5 = 100$  third numerator  
 And  $4 \times 5 \times 6 = 120$  common denominator  
 Therefore,  $\frac{90}{120}$ ,  $\frac{96}{120}$  and  $\frac{100}{120}$ , are the fractions required

Page 116.

3.  $1 \times 5 \times 15 \times 9 = 675$  first numerator  
 $3 \times 3 \times 15 \times 9 = 1215$  second '  
 $4 \times 3 \times 5 \times 9 = 540$  third '  
 $5 \times 3 \times 5 \times 15 = 1125$  fourth '

And  $3 \times 5 \times 15 \times 9 = 2025$  common denominatorTherefore,  $\frac{675}{2025}$ ,  $\frac{1215}{2025}$ ,  $\frac{540}{2025}$  and  $\frac{1125}{2025}$  are the frac. required

Case 5.

$$\begin{array}{r}
 2. \quad 4 \overline{) 3 \ 8 \ 12 \ 20} \\
 \quad \quad 3 \overline{) 3 \ 2 \ 3 \ 5} \\
 \quad \quad \quad 1 \ 2 \ 1 \ 5
 \end{array}$$

Now,  $4 \times 3 \times 2 \times 5 = 120$  common denominator

Then, 120 com. denominator

$$\text{Divisors} \left\{ \begin{array}{l|l} 3 & 40 \times 2 = 80 \\ 8 & 15 \times 3 = 45 \\ 12 & 10 \times 4 = 40 \\ 20 & 6 \times 5 = 30 \end{array} \right\} \text{New numerators}$$

Hence,  $\frac{80}{120}$ ,  $\frac{45}{120}$ ,  $\frac{40}{120}$  and  $\frac{30}{120}$ 

Page 117.

$$\begin{array}{r}
 3. \quad 3 \overline{) 3 \ 5 \ 15 \ 9} \\
 \quad \quad 5 \overline{) 1 \ 5 \ 5 \ 3} \\
 \quad \quad \quad 1 \ 1 \ 1 \ 3
 \end{array}$$

Now,  $3 \times 5 \times 3 = 45$  common denominator

Then, 45 com. denominator

$$\text{Divisors} \left\{ \begin{array}{l|l} 3 & 15 \times 1 = 15 \\ 5 & 9 \times 3 = 27 \\ 15 & 3 \times 4 = 12 \\ 9 & 5 \times 5 = 25 \end{array} \right\} \text{New numerators}$$

Hence,  $\frac{15}{45}$ ,  $\frac{27}{45}$ ,  $\frac{12}{45}$  and  $\frac{25}{45}$ 

Case 6.

2.  $7 \times 4 \times 9 = 252$  num.  
 $8 \times 6 \times 10 = 480$  denom.

$$\begin{array}{r}
 \text{Or, } \quad 3 \\
 7 \times \cancel{4} \times \cancel{6} \quad 7 \times 3 \\
 \hline
 \cancel{8} \ \cancel{6} \ 10 \quad 2 \times 2 \times 10 \\
 \hline
 2 \quad 2
 \end{array}
 = \frac{21}{40}$$

Hence,  $\frac{252}{480} = \frac{21}{40}$

Page 117.

3.  $5 \times 4 \times 3 = 60$  num.

$9 \times 8 \times 4 = 288$  denom.

Hence,  $\frac{60}{288} = \frac{5}{24}$

Or,  $\frac{5 \times \cancel{4} \times \cancel{3}}{\cancel{9} \times \cancel{8} \times 4} = \frac{5}{3 \times 2 \times 4} = \frac{5}{24}$

4.  $5 \times 4 \times 11 = 220$  num.

$9 \times 7 \times 12 = 756$  denom.

Hence,  $\frac{220}{756} = \frac{55}{189}$

Or,  $\frac{5 \times \cancel{4} \times 11}{9 \times 7 \times \cancel{12}} = \frac{5 \times 11}{9 \times 7 \times 3} = \frac{55}{189}$

Case 7.

2.  $\frac{4 \times 1 \times 1}{5 \times 20 \times 12} = \frac{1}{1200} = \frac{1}{300}$  fraction required

3.  $\frac{\cancel{9} \times 1 \times 1}{13 \times 8 \times \cancel{63}} = \frac{1}{13 \times 8 \times 7} = \frac{1}{728}$

Page 118.

4.  $\frac{\cancel{11} \times 1 \times 1}{11 \times \cancel{66} \times 24} = \frac{1}{11 \times 6 \times 24} = \frac{1}{1584}$

Case 8.

2.  $\frac{1 \times 12 \times 20}{300 \times 1 \times 1} = \frac{240}{300} = \frac{4}{5}$  fraction required

3.  $\frac{1 \times 63 \times 8}{728 \times 1 \times 1} = \frac{504}{728} = \frac{9}{13}$  fraction required

4.  $\frac{1 \times 24 \times 60}{1584 \times 1 \times 1} = \frac{1440}{1584} = \frac{10}{11}$  fraction required

Case 9.

2.  $\frac{12 \text{ ounces}}{3} = 1 \text{ pound}$

$$\begin{array}{r} 5 \overline{) 36} \\ \underline{\phantom{00}} \end{array}$$

7 ounces 4 pennyweights

Page 119.

3. 8 furlongs = 1 mile

$$\begin{array}{r} 4 \\ \underline{\phantom{00}} \end{array}$$

5) 32

6 furlongs 16 perches

8

4. 24 hours = 1 day

$$\begin{array}{r} 3 \\ \underline{\phantom{00}} \end{array}$$

10) 72

7 hours 12 min.

Page 119.

$$5. \quad \begin{array}{r} 100 \text{ cents} = 1 \text{ dollar} \\ 4 \\ \hline \end{array}$$

$$5 \overline{) 400}$$

80 cents

Case 10.

$$3. \quad \begin{array}{r} 31 \text{ galls. } 2 \text{ qts.} \\ 4 \\ \hline 126 \text{ quarts} \end{array} \qquad \begin{array}{r} 63 \text{ galls.} = 1 \text{ hhd.} \\ 4 \\ \hline 252 \text{ quarts} \end{array}$$

Wherefore,  $\frac{126}{252} = \frac{1}{2}$  is the fraction required

$$4. \quad \begin{array}{r} \text{cwt. } \text{qr. } \text{lb.} \\ 6 \quad 2 \quad 18\frac{2}{3} \\ 4 \\ \hline 26 \\ 28 \\ \hline 216 \\ 53 \\ \hline 746 \\ 3 \\ \hline \end{array}$$

$$\begin{array}{r} \text{cwt.} \\ 20 = 1 \text{ ton} \\ 4 \\ \hline 80 \\ 28 \\ \hline 2240 \\ 3 \\ \hline 6720 \text{ thirds of a pound} \end{array}$$

2240 thirds of a pound

Wherefore,  $\frac{2240}{6720} = \frac{1}{3}$  is the fraction required

Case 11. Page 120.

$$2. \quad 20 \overline{) 17,00} (,85$$

## ADDITION OF VULGAR FRACTIONS.

Case 1.

$$2. \quad \frac{4+8+13+16+19}{25} = \frac{60}{25} = 2\frac{2}{5}$$

$$3. \quad \frac{15+25+45+55}{60} = \frac{140}{60} = 2\frac{1}{3}$$

Case 2. Page 121.

Given denominators	40 com. denominator
2. $\begin{array}{r} 2 \overline{) 2 \ 4 \ 5 \ 8} \\ 2 \overline{) 1 \ 2 \ 5 \ 4} \\ \hline 1 \ 1 \ 5 \ 2 \end{array}$	And $\begin{array}{r l} 2 & 20 \text{ first numerator} \\ 4 & 10 \text{ second} \quad ' \\ 5 & 8 \text{ third} \quad ' \\ 8 & 5 \text{ fourth} \quad ' \end{array}$

Then,  $2 \times 2 \times 5 \times 2 = 40$  common denominator

Wherefore,  $\frac{20+10+8+5}{40} = \frac{43}{40} = 1\frac{3}{40}$

Given denominators	840 com. denominator
3. $\begin{array}{r} 5 \overline{) 5 \ 6 \ 7 \ 8 \ 15} \\ 3 \overline{) 1 \ 6 \ 7 \ 8 \ 3} \\ 2 \overline{) 1 \ 2 \ 7 \ 8 \ 1} \\ \hline 1 \ 1 \ 7 \ 4 \ 1 \end{array}$	Then, $\begin{array}{r l} 5 & 168 \times 4 = 672 \\ 6 & 140 \times 5 = 700 \\ 7 & 120 \times 6 = 720 \\ 8 & 105 \times 3 = 315 \\ 15 & 56 \times 8 = 448 \end{array}$

Now,  $5 \times 3 \times 2 \times 7 \times 4 = 840$  com. denom. 2855 sum

Wherefore,  $\frac{2855}{840} = 3\frac{67}{168}$

Case 3. Page 122.

3.  $\frac{4}{5}$  of  $\frac{1}{3} = \frac{4}{15}$

Then,  $\frac{3}{5} + \frac{4}{15} + \frac{3}{20} = \frac{36+16+9}{60} = \frac{61}{60} = 1\frac{1}{60}$

Wherefore,  $1 + 9 + 1\frac{1}{60} = 11\frac{1}{60}$

4.  $\frac{2}{3}$  of  $\frac{1}{2} = \frac{1}{3}$

Then,  $\frac{9}{10} + \frac{7}{8} + \frac{1}{6} + \frac{1}{2} = \frac{108+105+40+60}{120} = \frac{313}{120} = 2\frac{73}{120}$

Lastly,  $1 + 6 + 7 + 2\frac{73}{120} = 16\frac{73}{120}$

Case 4.

2. 
$$\begin{array}{r} \text{ft. in.} \\ \frac{1}{2} \text{ of a yard} = 1 \ 6 \\ \frac{2}{3} \text{ of a foot} = 0 \ 8 \\ \hline \end{array}$$

Sum 2 ft. 2 in

3. 
$$\begin{array}{r} \text{h. m.} \\ \frac{1}{3} \text{ of a day} = 8 \ 0 \\ \frac{1}{2} \text{ of an hour} = 0 \ 30 \\ \hline \end{array}$$

Sum 8 h. 30 mi.

Page 122.

	<i>d.</i>	<i>h.</i>	<i>m.</i>		<i>yds.</i>	<i>ft.</i>	<i>in.</i>
4. $\frac{1}{3}$ of a week	=	2	8	0	5. $\frac{7}{8}$ of a mile	=	1540 0 0
$\frac{1}{4}$ of a day	=	0	6	0	$\frac{2}{8}$ of a yard	=	0 2 0
$\frac{1}{2}$ of an hour	=	0	0	30	$\frac{3}{4}$ of a foot	=	0 0 9
Sum 2 d. 14 hrs. 30 mi.				1540y. 2ft. 9 in.			

## SUBTRACTION OF VULGAR FRACTIONS.

Page 123.

4.  $\frac{11}{12} - \frac{3}{4} = \frac{11}{12} - \frac{9}{12} = \frac{11-9}{12} = \frac{2}{12} = \frac{1}{6}$
5.  $\frac{5}{6} - \frac{4}{5} = \frac{25}{30} - \frac{24}{30} = \frac{25-24}{30} = \frac{1}{30}$
6.  $\frac{209}{216} - \frac{7}{144} = \frac{418}{432} - \frac{21}{432} = \frac{418-21}{432} = \frac{397}{432}$
7.  $\frac{15}{16} - \frac{11}{12} = \frac{45}{48} - \frac{44}{48} = \frac{45-44}{48} = \frac{1}{48}$
8.  $12\frac{5}{12} - 6\frac{1}{2} = 12\frac{5}{12} - 6\frac{6}{12} = 5\frac{11}{12}$
9.  $13\frac{1}{9} - 8\frac{14}{27} = 13\frac{3}{27} - 8\frac{14}{27} = 4\frac{16}{27}$
10.  $10\frac{3}{10} - 1\frac{7}{12} = 10\frac{18}{60} - 1\frac{35}{60} = 8\frac{43}{60}$
11.  $19\frac{5}{11} - \frac{7}{15} = 19\frac{75}{165} - \frac{77}{165} = 18\frac{163}{165}$

13.  $\frac{w.}{d.} \frac{h.}{m.}$   
 7 weeks = 7 0 0 0  
 $9\frac{7}{10}$  days = 1 2 16 48

Diff. 5 w. 4 d. 7 h. 12 min.

## MULTIPLICATION OF VULGAR FRACTIONS.

Page 124.

3.  $\frac{3}{8} \times \frac{4}{5} = \frac{12}{40} = \frac{3}{10}$
4.  $\frac{2}{5}$  of  $\frac{3}{4} = \frac{6}{20} = \frac{3}{10}$  Then,  $\frac{3}{10} \times \frac{1}{2} = \frac{3}{20}$
5.  $7\frac{1}{2} \times \frac{1}{4} = \frac{15}{2} \times \frac{1}{4} = \frac{15}{8} = 1\frac{7}{8}$
6.  $\frac{3}{4}$  of 9 =  $\frac{27}{4}$  Then,  $\frac{27}{4} \times \frac{7}{8} = \frac{189}{32} = 5\frac{29}{32}$

Page 124.

$$7. \quad 48\frac{3}{5} \times 13\frac{5}{6} = \frac{24^3}{5} \times \frac{83}{6} = \frac{672^3}{10} = 672\frac{3}{10}$$

## DIVISION OF VULGAR FRACTIONS.

Page 125.

$$3. \quad \frac{3}{8} \div \frac{6}{7} = \frac{3}{8} \times \frac{7}{6} = \frac{21}{48} = \frac{7}{16} \quad 4. \quad \frac{17}{21} \div \frac{3}{5} = \frac{17}{21} \times \frac{5}{3} = \frac{85}{63} = 1\frac{22}{63}$$

$$5. \quad 1\frac{1}{2} \div 4\frac{8}{10} = \frac{3}{2} \times \frac{5}{24} = \frac{15}{48} = \frac{5}{16} \quad 6. \quad \frac{7}{8} \div 4 = \frac{7}{8} \times \frac{1}{4} = \frac{7}{32}$$

$$7. \quad 9\frac{1}{6} = \frac{55}{6}, \text{ \& } \frac{1}{2} \text{ of } 7 = \frac{7}{2} \quad \text{Now, } \frac{55}{6} \div \frac{7}{2} = \frac{55}{6} \times \frac{2}{7} = \frac{110}{42} = 2\frac{13}{21}$$

$$8. \quad 5205\frac{1}{5} = \frac{26026}{5}, \text{ and } \frac{4}{5} \text{ of } 91 = \frac{364}{5}$$

$$\text{Now, } \frac{26026}{5} \div \frac{364}{5} = \frac{26026}{5} \times \frac{5}{364} = \frac{26026}{364} = 71\frac{1}{2}$$

## RULE OF THREE IN VULGAR FRACTIONS.

$$2. \quad \text{As } \frac{2}{3} \text{ ton. : } \frac{493}{3} \text{ dolls. (=164}\frac{1}{3} \text{ dolls.) : } \frac{6}{7} \text{ ton.}$$

$$\text{Then, } \frac{\cancel{3}}{2} \times \frac{493}{\cancel{3}} \times \frac{\cancel{6}}{7} = \frac{1479}{7} = 211\frac{284}{7}$$

$$3. \quad \frac{3}{4} \text{ of } \frac{3}{5} = \frac{9}{20}; \text{ Then, As } \frac{9}{20} : 171 : : 1 : \frac{19}{\cancel{171}} \times 20 = \frac{\text{dolls.}}{\text{dolls.}} = 380$$

$$4. \quad \text{As } \frac{\text{yd.}}{1} : \frac{\text{dolls.}}{\frac{5}{6}} : : 42 : \frac{\frac{7}{42} \times 5}{\cancel{6}} = \frac{\text{dolls.}}{35}$$

$$5. \quad \frac{2}{3} \text{ of } \frac{2}{5} = \frac{4}{15}; \text{ Then say,}$$

$$\text{As } \frac{\text{dolls.}}{\frac{4}{15}} : 312 : : 1 : \frac{312 \times 15}{4} = \frac{\text{dolls.}}{1170}$$

Page 126.

$$6. \quad 1\frac{1}{3} = \frac{4}{3}, 79\frac{1}{3} = \frac{238}{3}, \text{ and } 32\frac{1}{5} = \frac{17}{5}$$

$$\text{Now, as } \frac{4}{3} \text{ bu. : } \frac{238}{3} \text{ cts. : : } \frac{17}{5} \text{ bu. : } 202\frac{3}{10} \text{ cts.}$$

$$\text{Because, } \frac{\cancel{3}}{4} \times \frac{238}{\cancel{3}} \times \frac{17}{5} = \frac{4046}{20} = 202\frac{3}{10}$$

$$7. \quad \text{As } 17535 : \frac{1}{8} : : 60120 : \frac{3}{7}$$

$$\text{Because, } \frac{60120}{17535 \times 8} = \frac{60120}{140280} = \frac{3}{7}$$

## INVERSE PROPORTION.

Page 126.

$$2. \quad 6\frac{1}{2} \text{ cwt.} = \frac{13}{2} \text{ cwt. and } 22\frac{9}{26} = \frac{581}{26} \text{ miles}$$

$$\begin{array}{cccc} \text{cwt.} & \text{cwt.} & \text{mi.} & \text{miles} \\ \text{Now, as } 1 & : \frac{13}{2} & :: \frac{581}{26} & : 145\frac{1}{4} \end{array}$$

$$\text{Because, } \frac{13}{2} \times \frac{581}{26} = \frac{581}{2 \times 2} = 145\frac{1}{4} \text{ miles}$$

$$3. \quad \begin{array}{cccc} \text{men} & \text{men} & \text{days} & \text{days} \\ \text{As } 16 & : 12 & : \frac{183}{5} & (=37\frac{3}{5}) : 28\frac{1}{5} \text{ days} \end{array}$$

$$\begin{array}{c} 47 \quad 3 \\ \text{Because, } \frac{\cancel{183} \times \cancel{12}}{5 \times \cancel{16}} = \frac{141}{5} = 28\frac{1}{5} \text{ days} \\ \quad \quad \quad \cancel{4} \end{array}$$

$$4. \quad 100\frac{2}{3} \text{ dolls.} = \frac{302}{3} \text{ dolls. } 6\frac{2}{3} \text{ mo.} = \frac{20}{3} \text{ months}$$

$$3\frac{5}{6} \text{ years} = \frac{23}{6} \text{ years} = 46 \text{ months}$$

$$\begin{array}{cccc} \text{mo.} & \text{mo.} & \text{dolls.} & \\ \text{Then, as } 46 & : \frac{20}{3} & :: \frac{302}{3} & : 14\frac{122}{207} \text{ dollars.} \end{array}$$

$$\text{Because, } \frac{302 \times 20}{46 \times 3 \times 3} = \frac{6040}{414} = 14\frac{122}{207}$$

$$5. \quad \begin{array}{cccc} \text{ft.} & \text{ft.} & \text{ft.} & \text{ft.} \\ \text{As } \frac{7}{8} & : \frac{3}{4} & :: \frac{41}{2} & (=20\frac{1}{2}) : 17\frac{4}{7} \text{ feet} \end{array}$$

$$\text{Because, } \frac{\cancel{8}}{7} \times \frac{3}{\cancel{4}} \times \frac{41}{\cancel{2}} = \frac{3 \times 41}{7} = 17\frac{4}{7} \text{ feet}$$

$$6. \quad 20\frac{1}{2} \text{ yards} = \frac{41}{2} \text{ yards} \quad 1\frac{1}{4} \text{ yard} = \frac{5}{4} \text{ yards}$$

$$\text{Now, as } \frac{3}{4} \text{ yd.} : \frac{5}{4} \text{ yd.} :: \frac{41}{2} \text{ yd.} : 34\frac{1}{6} \text{ yards}$$

$$\text{Because, } \frac{\cancel{4}}{3} \times \frac{5}{\cancel{4}} \times \frac{41}{2} = \frac{205}{6} = 34\frac{1}{6} \text{ yards}$$

## INVOLUTION, OR RAISING OF POWERS.

Page 128.

$$2. \quad (35)^4 = 35 \times 35 \times 35 \times 35 = 1500625$$

$$3. \quad (1,03)^3 = 1,03 \times 1,03 \times 1,03 = 1,092727$$



Page 128.

$$4. \quad (,029)^5 = ,029 \times ,029 \times ,029 \times ,029 \times ,029 \\ = ,000000020511149^*$$

$$5. \quad \left(\frac{3}{4}\right)^4 = \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} = \frac{81}{256}$$

SQUARE ROOT.

Page 129.

<p>2. <math>\begin{array}{r} 106929(327 \text{ root required} \\ 9 \\ \hline 62)169 \\ 124 \\ \hline 647)4529 \\ 4529 \end{array}</math></p>	<p>3. <math>\begin{array}{r} 4762969(2187 \text{ root required} \\ 4 \\ \hline 41)78 \\ 41 \\ \hline 428)3729 \\ 3424 \\ \hline 4367)30569 \\ 30569 \end{array}</math></p>
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<p>4. <math>\begin{array}{r} 43046721(6561 \text{ root required} \\ 36 \\ \hline 125)704 \\ 625 \\ \hline 1306)7967 \\ 7836 \\ \hline 13121)13121 \\ 13121 \end{array}</math></p>	<p>5. <math>\begin{array}{r} 387420489(19683 \text{ root req.} \\ 1 \\ \hline 29)287 \\ 261 \\ \hline 436)2642 \\ 2316 \\ \hline 3928)32604 \\ 31424 \\ \hline 39363)118089 \\ 118089 \end{array}</math></p>
---	--

<p>6. <math>\begin{array}{r} 22071204(4698 \text{ root req.} \\ 16 \\ \hline 86)607 \\ 516 \\ \hline 929)9112 \\ 8361 \\ \hline 9388)75104 \\ 75104 \end{array}</math></p>	<p>7. <math>\begin{array}{r} 36372961(6031 \text{ root req.} \\ 36 \\ \hline 1203)03729 \\ 3609 \\ \hline 12061)12061 \\ 12061 \end{array}</math></p>
--	---

\* The answer given with the question is the 4th power of ,029.

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- |   |   |
|---|---|
| <p>3. <math>\dot{2}2\dot{6}8\dot{7}4\dot{1}(1506,23+\text{root req.}</math><br/> <math>\begin{array}{r} 1 \\ \hline \end{array}</math></p> <p>25) <math>\begin{array}{r} 126 \\ 125 \\ \hline \end{array}</math></p> <p>3006) <math>\begin{array}{r} 18741 \\ 18036 \\ \hline \end{array}</math></p> <p>30122) <math>\begin{array}{r} 70500 \\ 60244 \\ \hline \end{array}</math></p> <p>301243) <math>\begin{array}{r} 1025600 \\ 903729 \\ \hline \end{array}</math></p> <p>121871 remainder.</p> | <p>9. <math>\dot{7}596\dot{7}96(2756,228+\text{root req.}</math><br/> <math>\begin{array}{r} 4 \\ \hline \end{array}</math></p> <p>47) <math>\begin{array}{r} 359 \\ 329 \\ \hline \end{array}</math></p> <p>545) <math>\begin{array}{r} 3067 \\ 2725 \\ \hline \end{array}</math></p> <p>5506) <math>\begin{array}{r} 34296 \\ 33036 \\ \hline \end{array}</math></p> <p>55122) <math>\begin{array}{r} 126000 \\ 110244 \\ \hline \end{array}</math></p> <p>551242) <math>\begin{array}{r} 1575600 \\ 1102484 \\ \hline \end{array}</math></p> <p>5512448) <math>\begin{array}{r} 47311600 \\ 44099584 \\ \hline \end{array}</math></p> <p>3212016 remainder</p> |
|---|---|

Page 130.

- |  |  |
|--|--|
| <p>10. <math>\dot{9}7\dot{1}2,7\dot{1}80\dot{5}1(98,553+\text{root req.}</math><br/> <math>\begin{array}{r} 81 \\ \hline \end{array}</math></p> <p>188) <math>\begin{array}{r} 1612 \\ 1504 \\ \hline \end{array}</math></p> <p>1965) <math>\begin{array}{r} 10871 \\ 9825 \\ \hline \end{array}</math></p> <p>19705) <math>\begin{array}{r} 104680 \\ 98525 \\ \hline \end{array}</math></p> <p>197103) <math>\begin{array}{r} 615551 \\ 591309 \\ \hline \end{array}</math></p> <p>24242 remainder</p> | <p>11. <math>\dot{3},1\dot{7}2\dot{1}8\dot{1}2\dot{0}(1,78106+\text{root req.}</math><br/> <math>\begin{array}{r} 1 \\ \hline \end{array}</math></p> <p>27) <math>\begin{array}{r} 217 \\ 189 \\ \hline \end{array}</math></p> <p>348) <math>\begin{array}{r} 2821 \\ 2784 \\ \hline \end{array}</math></p> <p>3561) <math>\begin{array}{r} 3781 \\ 3561 \\ \hline \end{array}</math></p> <p>356206) <math>\begin{array}{r} 2202000 \\ 2137236 \\ \hline \end{array}</math></p> <p>64764 remainder</p> |
| <p>12. <math>\dot{4}79\dot{5},2\dot{5}7\dot{3}1\dot{0}(69,247+\text{root req.}</math><br/> <math>\begin{array}{r} 36 \\ \hline \end{array}</math></p> <p>129) <math>\begin{array}{r} 1195 \\ 1161 \\ \hline \end{array}</math></p> <p>1382) <math>\begin{array}{r} 3425 \\ 2764 \\ \hline \end{array}</math></p> <p>13844) <math>\begin{array}{r} 66173 \\ 55376 \\ \hline \end{array}</math></p> <p>138487) <math>\begin{array}{r} 1079710 \\ 969409 \\ \hline \end{array}</math></p> <p>110301</p>     | <p>13. <math>\dot{0},000088\dot{3}6(,0094 \text{ root req.}</math><br/> <math>\begin{array}{r} 81 \\ \hline \end{array}</math></p> <p>184) <math>\begin{array}{r} 736 \\ 736 \\ \hline \end{array}</math></p>  |

*Square Root of Vulgar Fractions.*

Page 130.

1. The greatest common divisor is 576

$$576) \frac{2304}{5184} = \frac{4}{9}; \text{ Then, } \sqrt{\frac{4}{9}} = \frac{2}{3}$$

2. The greatest common measure is 169

$$169) \frac{2704}{4225} = \frac{16}{25}; \text{ Now, } \sqrt{\frac{16}{25}} = \frac{4}{5}$$

$$3. \begin{array}{r} \dot{1}5\dot{6}2\dot{5} \end{array} (125 \text{ num.} \qquad \begin{array}{r} \dot{4}6\dot{6}5\dot{6} \end{array} (216 \text{ denom.}$$

1

4

$$22) 056$$

$$41) 066$$

44

41

$$245) 1225$$

$$426) 2556$$

1225

2556

That is  $\sqrt{\frac{15625}{46656}} = \frac{125}{216}$ , root required

*Surds.*

$$4. \frac{357}{476} = ,75; \text{ Then, } \sqrt{,75} = ,86602$$

$$5. \frac{478}{549} = ,8706739526 \text{ Then, } \sqrt{,8706739526} = ,93309$$

$$6. \frac{387}{738} = ,5243902439 \text{ Then, } \sqrt{,5243902439} = ,72414$$

*Square Root of mixed numbers.*

Page 131.

$$1. 37\frac{36}{49} = \frac{1849}{49} \text{ Then, } \sqrt{\frac{1849}{49}} = \frac{43}{7} = 6\frac{1}{7}$$

$$2. 27\frac{9}{16} = \frac{441}{16} \text{ Then, } \sqrt{\frac{441}{16}} = \frac{21}{4} = 5\frac{1}{4}$$

$$3. 51\frac{21}{25} = \frac{1296}{25} \text{ Then, } \sqrt{\frac{1296}{25}} = \frac{36}{5} = 7\frac{1}{5}$$

$$4. 9\frac{43}{49} = \frac{484}{49} \text{ Then, } \sqrt{\frac{484}{49}} = \frac{22}{7} = 3\frac{1}{7}$$

*Surds.*

$$5. \sqrt{7\frac{9}{11}} = \sqrt{7,818181 \text{ \&c.}} = 2,7961 +$$

$$6. \sqrt{8\frac{5}{7}} = \sqrt{8,71428571 \text{ \&c.}} = 2,9519 +$$

$$7. \sqrt{85\frac{14}{15}} = \sqrt{85,9333 \text{ \&c.}} = 9,27 +$$

*Any two sides of a right angled triangle given to find the third side.*

Page 132.

$$\begin{array}{r} 1. \quad 36 \times 36 = 1296 \\ 27 \times 27 = 729 \\ \hline \end{array}$$

Sum 2025

$$\begin{array}{r} 2. \quad 45 \times 45 = 2025 \\ 60 \times 60 = 3600 \\ \hline \end{array}$$

Sum 5625

Now,  $\sqrt{2025} = 45$  feet

Then,  $\sqrt{5625} = 75$  yards

$$\begin{array}{r} 3. \quad 45 \times 45 = 2025 \text{ AC squared} \\ 27 \times 27 = 729 \text{ AB squared} \\ \hline \end{array}$$

Diff. 1296 BC squared

$$\begin{array}{r} 4. \quad 75 \times 75 = 5625 \\ 45 \times 45 = 2025 \\ \hline \end{array}$$

Diff. 3600

Then,  $\sqrt{1296} = 36$  feet

Then,  $\sqrt{3600} = 60$  feet

*To find the side of a square equal in area to any given superficies.*

Page 133.

$$1. \quad \sqrt{160} = 12,6491106$$

$$2. \quad \sqrt{2025} = 45$$

$$3. \quad \sqrt{750} = 27,3861279$$

*To find the diameter of a circle of a given proportion, larger or less than a given one.*

$$1. \quad 4 \times 4 = 16, \text{ and } 16 \times 4 = 64 \quad \text{Then, } \sqrt{64} = 8 \text{ feet.}$$

$$2. \quad 100^2 \times 3 = 30000 \quad \text{Then, } \sqrt{30000} = 173,20508 \text{ feet.}$$

$$3. \quad \frac{12 \times 12}{2} = 72 \quad \text{Then, } \sqrt{72} = 8,4852814 \text{ inches}$$

*The area of a circle given to find the diameter.*

**RULE.** Divide the given area by ,7854 and the quotient is the square of the diameter.

Page 133.

$$1. \quad \sqrt{160 \div ,7854} = \sqrt{203,717850776674} = 14,272976$$

Or, by the rule in the "Calculator."

$$\begin{array}{r} \sqrt{160} = 12,6491106 \\ 1,12837 \end{array}$$

$$\begin{array}{r} 885437742 \\ 379473318 \\ 1011928848 \\ 252982212 \\ 1391402166 \\ \hline 14,272876927722 \text{ diameter} \end{array}$$

2. Because 160 perches is an acre, the diameter is the same as in the foregoing example. Consequently the half diameter, or length of the halter, will be

$$14,272976 \div 2 = 7,136488 \text{ perches}$$

$$16\frac{1}{2} \text{ feet}$$

$$\begin{array}{r} 114183808 \\ 3568244 \\ \hline \text{feet } 117,752052 \\ 12 \end{array}$$

$$\text{inches } 9,024624$$

117 feet 9 inches the length of the halter

### *Application.*

Page 134.

$$\text{Quest. 1. } \sqrt{20736} = 144 \text{ men} \quad 2. \quad 25 \times 25 = 625 \text{ feet}$$

$$3. \quad \sqrt{197136} = 444 \text{ stones}$$

4.  $600 \div \frac{40}{2} = \frac{600}{20} = 30$  the perpendicular. Because the perpendicular and the other side is the same, viz:—30 perches, the triangle is right angled. Consequently,

$$\sqrt{40^2 + 30^2} = \sqrt{1600 + 900} = \sqrt{2500} = 50 \text{ perches}$$

Page 134.

5.  $84 \times 84 = 7056$

$50 \times 50 = 2500$

$\underline{\quad\quad\quad}$   
9556

Then,  $\sqrt{9556} = 97,7547 + \text{miles}$

6.  $\overset{\cdot}{9}\overset{\cdot}{6}\overset{\cdot}{4},\overset{\cdot}{5}\overset{\cdot}{1}\overset{\cdot}{9}\overset{\cdot}{2}\overset{\cdot}{3}\overset{\cdot}{6}\overset{\cdot}{0}\overset{\cdot}{2}\overset{\cdot}{4}\overset{\cdot}{1}(31,05671$  *root required*  
 $\underline{\quad\quad\quad}$   
9

61)  $\overset{\cdot}{6}\overset{\cdot}{4}$   
 $\underline{\quad\quad}$   
61

6205)  $\overset{\cdot}{3}\overset{\cdot}{5}\overset{\cdot}{1}\overset{\cdot}{9}\overset{\cdot}{2}$   
 $\underline{\quad\quad}$   
31025

62106)  $\overset{\cdot}{4}\overset{\cdot}{1}\overset{\cdot}{6}\overset{\cdot}{7}\overset{\cdot}{3}\overset{\cdot}{6}$   
 $\underline{\quad\quad}$   
372636

621127)  $\overset{\cdot}{4}\overset{\cdot}{4}\overset{\cdot}{1}\overset{\cdot}{0}\overset{\cdot}{0}\overset{\cdot}{0}\overset{\cdot}{2}$   
 $\underline{\quad\quad}$   
4347889

6211341)  $\overset{\cdot}{6}\overset{\cdot}{2}\overset{\cdot}{1}\overset{\cdot}{1}\overset{\cdot}{3}\overset{\cdot}{4}\overset{\cdot}{1}$   
 $\underline{\quad\quad}$   
6211341

7.  $\overset{\cdot}{1}\overset{\cdot}{0}\overset{\cdot}{3}\overset{\cdot}{0}\overset{\cdot}{8}\overset{\cdot}{9}\overset{\cdot}{2}\overset{\cdot}{1}\overset{\cdot}{9}\overset{\cdot}{8},\overset{\cdot}{4}\overset{\cdot}{0}\overset{\cdot}{0}\overset{\cdot}{1}(32107,51$  *root required*  
 $\underline{\quad\quad\quad}$   
9

62)  $\overset{\cdot}{1}\overset{\cdot}{3}\overset{\cdot}{0}$   
 $\underline{\quad\quad}$   
124

641)  $\overset{\cdot}{6}\overset{\cdot}{3}\overset{\cdot}{9}$   
 $\underline{\quad\quad}$   
641

64207)  $\overset{\cdot}{4}\overset{\cdot}{8}\overset{\cdot}{2}\overset{\cdot}{1}\overset{\cdot}{9}\overset{\cdot}{8}$   
 $\underline{\quad\quad}$   
449449

642145)  $\overset{\cdot}{3}\overset{\cdot}{2}\overset{\cdot}{7}\overset{\cdot}{4}\overset{\cdot}{9}\overset{\cdot}{4}\overset{\cdot}{0}$   
 $\underline{\quad\quad}$   
3210725

6421501)  $\overset{\cdot}{6}\overset{\cdot}{4}\overset{\cdot}{2}\overset{\cdot}{1}\overset{\cdot}{5}\overset{\cdot}{0}\overset{\cdot}{1}$   
 $\underline{\quad\quad}$   
6421501

## CUBE ROOT.

Page 138.

2.  $2 \times 2 \times 3 = 12..$

square of 4 = 16

$2 \times 4 \times 30 = 240$   
 $\underline{\quad\quad}$

complete divisor  $1456 \times 4 =$

$\overset{\cdot}{1}\overset{\cdot}{3}\overset{\cdot}{8}\overset{\cdot}{2}\overset{\cdot}{4}(24 \text{ root required}$

$\underline{\quad\quad}$   
8

5824

$\underline{\quad\quad}$   
5824

3.  $7 \times 7 \times 3 = 147..$

square of 2 = 04

$7 \times 2 \times 30 = 420$   
 $\underline{\quad\quad}$

complete divisor  $15124 \times 2 = 30248$

$\overset{\cdot}{3}\overset{\cdot}{7}\overset{\cdot}{3}\overset{\cdot}{2}\overset{\cdot}{4}\overset{\cdot}{8}(72 \text{ root required}$

$\underline{\quad\quad}$   
343

30248

4.  $1 \times 1 \times 3 = 3..$

square of 7 = 49

$1 \times 7 \times 30 = 210$   
 $\underline{\quad\quad}$

complete divisor  $559 \times 7 = 3913$

$\overset{\cdot}{5}\overset{\cdot}{7}\overset{\cdot}{3}\overset{\cdot}{5}\overset{\cdot}{3}\overset{\cdot}{3}\overset{\cdot}{9}(179 \text{ root required}$

$\underline{\quad\quad}$   
1

4735

complete divisor  $559 \times 7 = 3913$

$\underline{\quad\quad}$   
822339

17  $\times$  17  $\times$  3 = 867..

square of 9 = 81

17  $\times$  9  $\times$  30 = 4590

complete divis.  $91371 \times 9 = 822339$

Page 138.

$$\begin{array}{r}
 5. \quad 4 \times 4 \times 3 = 48.. \quad 84604519 \text{ (439 root required)} \\
 \text{square of } 3 = 09 \quad 64 \\
 4 \times 3 \times 30 = 360 \quad \text{—} \\
 \hline
 \quad \quad \quad 20604
 \end{array}$$

$$\text{complete divisor } 5169 \times 3 = 15507$$

$$\begin{array}{r}
 43 \times 43 \times 3 = 5547.. \quad 5097519 \\
 \text{square of } 9 = 81 \\
 43 \times 9 \times 30 = 11610 \\
 \hline
 \end{array}$$

$$\text{comp. divisor } 566391 \times 9 = 5097519$$

$$\begin{array}{r}
 6. \quad 3 \times 3 \times 3 = 27.. \quad 27054036008 \text{ (3002 root)} \\
 \text{defective divisor } 2700.. \quad 27 \\
 \text{defective divisor } 270000.. \quad \text{—} \\
 \text{square of } 2 = 04 \quad 054036008 \\
 300 \times 2 \times 30 = 18000 \\
 \hline
 \end{array}$$

$$\text{complete divisor } 27018004 \times 2 = 54036008$$

$$\begin{array}{r}
 7. \quad 4 \times 4 \times 3 = 48.. \quad 122615327232 \text{ (4968 root)} \\
 \text{square of } 9 = 81 \quad 64 \\
 4 \times 9 \times 30 = 1080 \quad \text{—} \\
 \hline
 \quad \quad \quad 58615
 \end{array}$$

$$\text{complete divisor } 5961 \times 9 = 53649$$

$$9^2 \times 2 \quad 162 \quad 4966327 \text{ dividend}$$

$$\begin{array}{r}
 \text{defective divisor}^* 7203.. \\
 \text{square of } 6 = 36 \\
 49 \times 6 \times 30 = 8820 \\
 \hline
 \end{array}$$

$$\text{complete divisor } 729156 \times 6 = 4374936 \text{ subtrahend}$$

$$6^2 \times 2 = 72 \quad 591391232 \text{ dividend}$$

$$\begin{array}{r}
 \text{defective divisor } 738048.. \\
 \text{square of } 8 = 64 \\
 496 \times 8 \times 30 = 119040 \\
 \hline
 \end{array}$$

$$\text{complete divisor } 73923904 \times 8 = 591391232 \text{ subtrahend}$$

\* *Defective divisors*, after the first, may be more concisely found by addition, thus: To the last complete divisor, add the number which completed it, with twice the square of the last figure in the root; the sum will be the next defective divisor.

Page 133.

$$\begin{array}{rcl}
 8. & 2 \times 2 \times 3 = 12.. & 22069810125(2805 \text{ root} \\
 & \text{square of } 8 = 64 & 8 \\
 & 2 \times 8 \times 30 = 480 & \text{---} \\
 & & 14069 \\
 & \text{complete divisor } 1744 \times 8 = & 13952 \\
 & 480 & \text{---} \\
 & 8^2 \times 2 = 128 & 117810125 \text{ dividend}
 \end{array}$$

$$\begin{array}{rcl}
 \text{defective divisor} & 235200.. & \\
 \text{square of } 5 = & 25 & \\
 280 \times 5 \times 30 = & 42000 & \\
 \hline
 \end{array}$$

$$\text{complete divisor } 23562025 \times 5 = 117810125 \text{ subtrahend}$$

$$\begin{array}{rcl}
 9. & 6 \times 6 \times 3 = 108.. & 219365327791(6031 \\
 \text{defective divisor} & 10800.. & 216
 \end{array}$$

$$\begin{array}{rcl}
 & \text{square of } 3 = 09 & 3365327 \\
 & 60 \times 3 \times 30 = 5400 & \text{---} \\
 \text{complete divisor } 1085409 \times 3 = & 3256227 & \\
 & 5400 & \text{---} \\
 \text{square of } 3 \times 2 = & 18 & 109100791
 \end{array}$$

$$\begin{array}{rcl}
 \text{defective divisor} & 1090827.. & \\
 \text{square of } 1 = & 01 & \\
 603 \times 1 \times 30 = & 18090 & \\
 \hline
 \end{array}$$

$$109100791 \times 1 = 109100791$$

$$\begin{array}{rcl}
 10 & 8 \times 8 \times 3 = 192.. & 673373097125(8765 \text{ root required} \\
 & \text{square of } 7 = 49 & 512
 \end{array}$$

$$\begin{array}{rcl}
 & 8 \times 7 \times 30 = 1680 & 161373 \\
 \text{complete divisor } 20929 \times 7 = & 146503 & \\
 & 1680 & \text{---} \\
 & & 14870097
 \end{array}$$

$$\begin{array}{rcl}
 \text{twice the sq. of } 7 = & 98 & \\
 \text{defective divisor} & 22707.. & \\
 \text{square of } 6 = & 36 & \\
 87 \times 6 \times 30 = & 15660 & \\
 \hline
 \end{array}$$

$$\begin{array}{rcl}
 \text{complete divisor } 2286396 \times 6 = & 13718376 & \\
 & 15660 & \text{---} \\
 & & 1151721125
 \end{array}$$

$$\begin{array}{rcl}
 \text{twice the sq. of } 6 = & 72 & \\
 \text{defective divisor} & 2302128.. & \\
 \text{square of } 5 = & 25 & \\
 876 \times 5 \times 30 = & 131400 & \\
 \hline
 \end{array}$$

$$\text{complete divisor } 230344225 \times 5 = 1151721125$$



Page 138.

11.	$2 \times 2 \times 3 = 12..$	12,977875(2,35 root
	square of 3= 09	8
	$2 \times 3 \times 30 = 180$	<u>4977</u>
	complete divisor $1389 \times 3 =$	4167
	180	<u>          </u>
twice the sq. of 3=	18	810875
	defective divisor $1586..$	
	square of 5= 25	
	$23 \times 5 \times 30 = 3450$	
	complete divisor $162175 \times 5 =$	810875
12.	$2 \times 2 \times 3 = 12..$	15926,972504(25,16+
	square of 5= 25	8
	$2 \times 5 \times 30 = 300$	<u>          </u>
		7926
	complete divisor $1525 \times 5 =$	7625
	300	<u>          </u>
twice the sq. of 5=	50	301972
	defective divisor $1875..$	
	square of 1= 01	
	$25 \times 1 \times 30 = 750$	
	complete divisor $188251 \times 1 =$	188251
	750	<u>          </u>
twice the sq. of 1=	2	113721504
	defective divisor $189003..$	
	square of 6= 36	
	$251 \times 6 \times 300 = 45180$	
	complete divisor $18945516 \times 6 =$	113673096
		<u>          </u>
		48408 rem.
13.	$3 \times 3 \times 3 = 27..$	36155,027576(33,06
	square of 3= 09	27
	$3 \times 3 \times 30 = 270$	<u>9155</u>
	complete divisor $2979 \times 3 =$	8937
	$33 \times 33 \times 3 = 3267..$	<u>218027576</u>
defective divisor	$326700..$	
	square of 6= 36	
	$330 \times 6 \times 30 = 59400$	
	complete divisor $32729436 \times 6 =$	196376616
		<u>          </u>
		21650960 rem.

$$\begin{array}{rcl}
 14. & 3 \times 3 \times 3 = 27.. & ,053258279(,376 + \text{root} \\
 & \text{square of } 7 = 49 & 27 \\
 & 3 \times 7 \times 30 = 630 & \text{---} \\
 & & 26258 \\
 \text{complete divisor } 3379 \times 7 = & 23653 & \text{---} \\
 & & 2605279 \\
 & 37 \times 37 \times 3 = 4107.. & \\
 & \text{square of } 6 = 36 & \\
 & 37 \times 3 \times 30 = 3330 & \text{---} \\
 \text{complete divisor } 414066 \times 6 = & 2484396 & \text{---} \\
 & & 120883 \text{ remainder}
 \end{array}$$

$$\begin{array}{rcl}
 15. & 1 \times 1 \times 3 = 3.. & ,001906624(,124 \text{ root} \\
 & \text{square of } 2 = 04 & 1 \\
 & 1 \times 2 \times 30 = 60 & \text{---} \\
 & & 906 \\
 \text{complete divisor } 364 \times 2 = & 728 & \text{---} \\
 & & 178624 \\
 & 12 \times 12 \times 3 = 432.. & \\
 & \text{square of } 4 = 16 & \\
 & 12 \times 4 \times 30 = 1440 & \text{---} \\
 \text{complete divisor } 44656 \times 4 = & 178624 & \text{---}
 \end{array}$$

$$\begin{array}{rcl}
 16. & ,000000729(,009 \text{ root required} & \\
 & 729 &
 \end{array}$$

$$\begin{array}{rcl}
 17. & 1 \times 1 \times 3 = 3.. & 2,(1,25 + \text{root} \\
 & \text{square of } 2 = 04 & 1 \\
 & 1 \times 2 \times 30 = 60 & \text{---} \\
 & & 1000 \\
 \text{complete divisor } 364 \times 2 = & 728 & \text{---} \\
 & & 272000 \\
 & 12 \times 12 \times 3 = 432.. & \\
 & \text{square of } 5 = 25 & \\
 & 12 \times 5 \times 30 = 1800 & \text{---} \\
 \text{complete divisor } 45025 \times 5 = & 225125 & \text{---} \\
 & & 46875 \text{ remainder}
 \end{array}$$

Page 139.

*To extract the cube root of a vulgar fraction.*

1.  $\frac{250}{686} = \frac{125}{343}$  Then,  $\sqrt[3]{\frac{125}{343}} = \frac{5}{7}$  root required
2.  $\frac{324}{1500} = \frac{27}{125}$  Then,  $\sqrt[3]{\frac{27}{125}} = \frac{3}{5}$  root required
3.  $\frac{1520}{5130} = \frac{8}{27}$  Then,  $\sqrt[3]{\frac{8}{27}} = \frac{2}{3}$  root required

*Surds.*

4.  $\sqrt[3]{\frac{4}{7}} = \sqrt[3]{571428571 \text{ \&c.}} = ,829 + \text{root required}$
5.  $\sqrt[3]{\frac{2}{3}} = \sqrt[3]{,666 \text{ \&c.}} = ,873 + \text{root required}$
6.  $\sqrt[3]{\frac{5}{9}} = \sqrt[3]{,555 \text{ \&c.}} = ,822 + \text{root required}$

*To extract the cube root of a mixed number.*

1.  $\sqrt[3]{31\frac{15}{343}} = \sqrt[3]{10648} = \frac{22}{7} = 3\frac{1}{7}$
2.  $\sqrt[3]{12\frac{9}{27}} = \sqrt[3]{\frac{343}{27}} = \frac{7}{3} = 2\frac{1}{3}$
3.  $\sqrt[3]{405\frac{28}{125}} = \sqrt[3]{\frac{50653}{125}} = \frac{37}{5} = 7\frac{2}{5}$

*Surds.*

Page 140.

4.  $\sqrt[3]{7\frac{1}{5}} = \sqrt[3]{7,2} = 1,93 + \text{root required}$
5.  $\sqrt[3]{8\frac{5}{7}} = \sqrt[3]{8,7142857 \text{ \&c.}} = 2,057 + \text{root required}$
6.  $\sqrt[3]{9\frac{1}{6}} = \sqrt[3]{9,166 \text{ \&c.}} = 2,092 + \text{root required}$

*To find the side of a cube that shall be equal to any given solid, as a globe, a cone, &c.*

1.  $\sqrt[3]{10648} = 22$
2.  $\sqrt[3]{389017} = 73$

*Note.*

1.  $2^3 \times 3 = 2 \times 2 \times 2 \times 3 = 24$

Then,  $\sqrt[3]{24} = 2,8845 \text{ feet} = 2 \text{ feet } 10,614 \text{ inches}$ 

2.  $12^3 \times 3 = 12 \times 12 \times 12 \times 3 = 5184$

Then,  $\sqrt[3]{5184} = 17,306 \text{ inches}$

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*Application.*

*Quest.* 1. As  $6^3 : 3^3 \therefore 216 : 27 :: 32 \text{ lb.} : 4 \text{ lb.}$

2.  $288 \times 216 \times 48 = 2985984$  Then,  $\sqrt[3]{2985984} = 144$

3.  $\sqrt[3]{389017} = 73$  Then,  $73 \times 73 = 5329$

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*Quest.* 4. Because there is two half feet in a foot.

$$\frac{2 \times 2 \times 2}{2} = \frac{8}{2} = 4 \text{ solid half feet in half a solid foot}$$

And then,  $4 - 1 = 3$  solid half feet

5.  $2 \times 2 \times 2 = 8$  six inch cubes. And because there are three times 4 inches in a foot we find that there is  $3 \times 3 \times 3 = 27$  four inch cubes in a solid foot.

**ARITHMETICAL PROGRESSION.**

Case 1. Page 142.

2.  $(\overline{20-1} \times 3) + 3 = (19 \times 3) + 3 = 60$  last term

Then,  $(60 + 3) \times \frac{2^0}{2} = 63 \times 10 = 6$  dollars 30 cents

3. Here 4 is the common difference

And  $(\overline{100-1} \times 4) + 4 = (99 \times 4) + 4 = 400$  last term

Then,  $(400 + 4) \times \frac{1^0 0}{2} = 404 \times 50 = 20200$  yards

But, 20200 yards = 11 miles 3 furlongs 180 yards

Page 143.

4.  $(\overline{10-1} \times 10) + 20 = 90 + 20 = 110$  dollars last term

Then,  $(110 + 20) \times \frac{1^0}{2} = 130 \times 5 = 650$  dollars the whole amount. And  $650 \div 10 = 65$  dollars per annum

5.  $(\overline{1000-1} \times 10) + 10 = 9990 + 10 = 10000$  cents, or 100 dollars for the last acre

And  $(10000 + 10) \times \frac{1^0 0 0}{2} = 50050$  dollars, whole cost

Case 2. Page 143.

$$2. \quad \frac{60-20}{21-1} = \frac{40}{20} = 2 \text{ the common difference}$$

Then, 20, 22, 24, 26, 28, &c. are their ages respectively

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$$3. \quad \frac{58-3}{12-1} = \frac{55}{11} = 5 \text{ miles daily increase}$$

And  $(58+3) \times \frac{1}{2} = 61 \times 6 = 366$  miles whole distance

## GEOMETRICAL PROGRESSION.

Page 146.

2.	Indices	1	2	3	4
	Ratio	2,	4,	8,	16, powers of the ratio
				16	

In this question the  
number of terms is 12

$$\begin{array}{l} 256 = 8\text{th power} \\ 8 = 3\text{d power} \end{array}$$

$$\begin{array}{l} 2048 = 11\text{th power of the ratio} \\ \times 1 \text{ the first term} \end{array}$$

$$\begin{array}{l} 2038 = 12\text{th or last term of the} \\ \times 2 \text{ the ratio} \end{array} \quad \begin{array}{l} \text{[progression} \\ \text{]} \end{array}$$

$$4096$$

Subtract 1 the first term

$$\text{Ratio } 2-1=1) 4095$$

\$4095 the sum of the series

3.	Indices	1	2	3	4	5
	Ratio	2,	4,	8,	16,	32, powers of the ratio
						32

$$64$$

Here the number of  
terms is 15

$$\begin{array}{l} 1024 = 10\text{th power} \\ 16 = 4\text{th power} \end{array}$$

$$16384 = 14\text{th power of the ratio}$$

And because the first term of the progression is 1, the 14th power of the ratio is the last, or 15th term of the progression

$$\text{Then, } \frac{(16384 \times 2 \text{ ratio}) - 1}{\text{Ratio } 2-1} = 32767 \text{ shillings} = 1638\text{£. } 7\text{s.}$$

Page 146.

4. Indices 1 2 3 4  
Ratio 4, 16, 64, 256, powers of the ratio  
256

---

1536

Here the number of terms is 12

1280

---

512

---

65536 = 8th power

---

64 = 3d power

---

262144

---

393216

---

4194304 = 11th power of the ratio, which

is also the 12th or last term of the progression.

Then,  $\frac{(4194304 \times 4) - 1}{4 - 1} = 55924 \overset{\text{dolls.}}{\text{cts.}}$  05 sold for

And  $12 \times 20 = 240$  00 cost

---

\$55684 05 gain

5. Indices 1 2 3 4 5 6 7  
Ratio 2, 4, 8, 16, 32, 64, 128, powers of the ratio  
128

Here the number of terms is 32

---

1024

256

---

128

---

16384 = 14th power

---

16384 = do.

---

65536

131072

49152

98304

---

16384

---

268435456 = 28th power

---

8 = 3d power

---

2147483648 = 31st power of the

ratio: And because the first term of the progression is 1, it is also the 32d or last term of the progression

Then,  $\frac{(2147483648 \times 2) - 1}{2 - 1} = 4294967$  d. 29 cts. 5 ms.

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6. Indices 1 2 3 4 5  
Ratio 3, 9, 27, 81, 243, powers of the ratio

243

729

972

486

59049 = 10th power

59049 = do.

531441

236196

5314410

295245

3486784401 = 20th power

59049 = 10th power

31381059609

13947137604

313810596090

17433922005

205891132094649 = 30th power

3 = single power

617673396283947 = 31st power of the ratio, or  
32d term of the progression

Then,  $\frac{(617673396283947 \times 3) - 1}{\text{Ratio } 3 - 1} = 926510094425 \text{ d. } 92 \text{ c.}$

$$7. \quad 1 \times \frac{(4^{32} - 1)}{4 - 1} = \frac{18446744073709551615}{3} =$$

6148914691236517 dollars 20 cents 5 mills

$$8. \quad 2 \times \frac{(3^{30} - 1)}{3 - 1} = \frac{2 \times 205891132094648}{2} =$$

205891132094648 pins. Which at 1000 for a farthing  
amounts to £214469929 5 3½

cost of 30 yards at £100 = 3000 0 0

gain £214466929 5 3½

## SINGLE POSITION.

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3. Suppose A paid 12 dollars

Then B 4 ‘

And C 1 ‘

---

 17 sum

*dolls.*  
 Now, as 17 : 340 ::  $\left\{ \begin{array}{l} 12 : 240 \text{ A paid} \\ 4 : 80 \text{ B } ' \\ 1 : 20 \text{ C } ' \end{array} \right.$

4. Suppose 60

---

 $\frac{1}{4} = 15$

$\frac{1}{5} = 12$

$\frac{1}{6} = 10$

---

 37

Now, as 37 : 60 :: 148 :  $\frac{148 \times 60}{37} = 240d.$

5. Suppose 12

---

 $\frac{1}{2} = 6$

$\frac{1}{3} = 4$

---

 10

---

 left 2

Then, as 2 : 12 ::  $26\frac{2}{3}$  dolls. : 160 dolls.

6. Suppose A's age 6

Then B's =  $6 \times 1\frac{1}{2} = 9$ And C's =  $(6 + 9) \times 2\frac{1}{10} = 31\frac{1}{2}$ 

---

 $46\frac{1}{2}$

Then, as 46,5 : 93 ::  $\left\{ \begin{array}{l} 6 : 12 \text{ A's age} \\ 9 : 18 \text{ B's } ' \\ 31,5 : 63 \text{ C's } ' \end{array} \right.$

7. Suppose 1 to be the number

Then,  $\frac{7}{8} - \frac{4}{5} = \frac{35 - 32}{40} = \frac{3}{40}$  difference

Now, as  $\frac{3}{40} : 1 :: 6 : \frac{6 \times 40}{3} = 80$



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8. Suppose 1 the harness  
 then 2 ' horse  
 and 6 ' chaise  
 —  
 9

*dolls.*  
 Then, as 9 : 360 ::  $\left\{ \begin{array}{l} 1 : 40 \text{ dollars harness} \\ 2 : 80 \text{ dollars horse} \\ 6 : 240 \text{ dollars chaise} \end{array} \right.$

9. Suppose 60  
 —  
 $\frac{1}{3} = 20$   
 $\frac{1}{4} = 15$   
 $\frac{1}{5} = 12$   
 $\frac{1}{6} = 10$   
 —  
 57

10. Suppose 12  
 $\frac{1}{3} = 4$   
 —  
 A spends 8  
 2  
 —  
 B spends 16  
 12  
 —  
 B sinks 4

Now, *dolls. dolls.*  
 as 57 : 60 :: 228 : 240

*dolls. dolls.*  
 Then, as 4 : 12 :: 50 : 150

## DOUBLE POSITION.

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2. Suppose 8  
 $\frac{1}{8} = 1$   
 —

A spends 7  
 30  
 —

B spends 37 per year  
 8  
 —

B spends 296 in 8 years  
 $8 \times 8 = 64$   
 —

B is indebted 232  
 40  
 —

192 error too little

192 error  $\times 40 = 7680$ 160 error  $\times 8 = 1280$ 

6400 difference of the products  
 192—160=32 the difference of the errors

Again, suppose 40  
 $\frac{1}{8} = 5$   
 —

A spends 35 per year  
 30  
 —

B spends 65 per year  
 8  
 —

B spends 520 in 8 yrs.  
 $40 \times 8 = 320$   
 —

B is indebted 200  
 40  
 —

160 e. too lit.

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Question 2d continued.

Then,  $6400 \div 32 = 200$  dollars their incomeAnd  $200 - 2\frac{0}{8}0 = 200 - 25 = 175$  dolls. A spends per annumAlso,  $175 + 30 = 205$  dollars B spends per annum

3. Suppose A's 12

Then B's is 15

And C's ' 19

---

46

100

---

Error 54 too little

 $54 \times 40 = 2160$  $30 \times 12 = 360$ 

---

2520 sum of the products

And  $54 + 30 = 84$  sum of the errorsThen,  $2520 \div 84 = 30$  A's share $30 + 3 = 33$  B's share $33 + 4 = 37$  C's share

Again, suppose A's 40

Then B's is 43

And C's ' 47

---

130

100

---

Error 30 too much

4. Suppose A paid 100

then B ' 1100

and C ' 1200

---

2400

10000

---

error 7600

Again, suppose A paid 200

then B ' 1200

and C ' 1400

---

2800

10000

---

error 7200

Errors are alike, i. e. both too little

 $7600 \times 200 = 1520000$  $7200 \times 100 = 720000$ 

---

Diff. of the products, 800000

 $7600 - 7200 = 400$  difference of the errorsThen,  $800000 \div 400 = 2000$  dollars A paidAnd  $2000 + 1000 = 3000$  dollars B paidAlso  $2000 + 3000 = 5000$  dollars C paid

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5. Suppose first horse \$10	Again, sup. first horse \$20
50	50
<hr/>	<hr/>
2)60	2)70
<hr/>	<hr/>
The second horse 30	Then, second horse 35
50	50
<hr/>	<hr/>
80	85
$10 \times 3 = 30$	$20 \times 3 = 60$
<hr/>	<hr/>
Error too little 50	error too little 25
$50 \times 20 = 1000$	50
$25 \times 10 = 250$	25
<hr/>	<hr/>
Diff. of the prod. 750	Diff. of the errors 25

Then,  $750 \div 25 = 30$  dollars first horseAnd  $\frac{30 + 50}{2} = 40$  dollars second horse

6. Suppose 20 body	Again, suppose 30 body
<hr/>	<hr/>
Then, $\frac{20}{2} + 9 = 19$ tail	Then, $\frac{30}{2} + 9 = 24$ tail
9 head	9 head
<hr/>	<hr/>
Head and tail = 28	Head and tail 33
body = 20	body 30
<hr/>	<hr/>
error 8 too little	error 3 too little
$30 \times 8 = 240$	$8 - 3 = 5$ difference of the errors
$20 \times 3 = 60$	
<hr/>	
Then, $180 \div 5 = 36$ inches the body	
Diff. of pro. 180	And $\frac{36}{2} + 9 = 27$
	9
	tail
	head
	<hr/>
	72 in. = 6 feet

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7. Suppose he wrought 20 days, and was idle 20

Then, 20 days  $\times$  20 cents = 40020 '  $\times$  10 ' = 200

He would receive	200 cents
	<u>500</u>

error too little 300

Again, suppose he wrought 25 days, and was idle 15

Then, 25 days  $\times$  20 cents = 50015 '  $\times$  10 ' = 150

He would receive	350
	<u>500</u>

error 150 too little

 $25 \times 300 = 7500$  $20 \times 150 = 3000$      $300 - 150 = 150$  difference of the errors

Diff. of pro. 4500

Then,  $4500 \div 150 = 30$  days wroughtAnd  $40 - 30 = 10$  days idle

8. Suppose each had 300 dollars

Then,  $300 + \frac{300}{4} = 300 + 75 = 375$ And  $(300 - 225) \times 2 = 75 \times 2 = 150$ 

Difference 225 error

Again, suppose each had 400 dollars

Then,  $400 + \frac{400}{4} = 400 + 100 = 500$ And  $(400 - 225) \times 2 = 175 \times 2 = 350$ 

Difference 150 err.

Errors alike.

Now,  $400 \times 225 = 90000$ And  $300 \times 150 = 45000$ 

Diff. of the products 4500

And  $225 - 150 = 75$  difference of the errorsThen,  $4500 \div 75 = 600$  dollars

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9. Suppose the parts  
to be 8 and 7

$$\begin{array}{r} \text{Then, } 8 \times 4 = 32 \\ 7 \times 16 = 112 \\ \hline \end{array}$$

80 error

Again, suppose the parts  
to be 10 and 5

$$\begin{array}{r} \text{Then, } 10 \times 4 = 40 \\ 5 \times 16 = 80 \\ \hline \end{array}$$

40 error

Errors alike.

$$10 \times 80 = 800$$

$$80 - 40 = 40 \text{ difference of the errors}$$

$$8 \times 40 = 320 \quad \text{Then, } 480 \div 40 = 12 \text{ the greater}$$

Diff. of pro. 480

And  $15 - 12 = 3$  the less

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10. Suppose 1 o'clock

$$\text{Then, } \left(\frac{2}{13} \text{ of } 11\right) \oslash 1 = \frac{22-13}{13} = \frac{9}{13} \text{ error}$$

Again, suppose it to be two of the clock,

$$\text{Then, } \left(\frac{2}{13} \text{ of } 10\right) \oslash 2 = \frac{26-20}{13} = \frac{6}{13} \text{ error}$$

Errors unlike.

$$\text{Now, } \frac{9}{13} \times 2 = \frac{18}{13}, \text{ and } \frac{6}{13} \times 1 = \frac{6}{13}$$

$$\text{Then, } \frac{18}{13} + \frac{6}{13} = \frac{24}{13} \text{ the sum of the products}$$

$$\text{And } \frac{9}{13} + \frac{6}{13} = \frac{15}{13} \text{ the sum of the errors}$$

$$\text{Lastly, } \frac{24}{13} \div \frac{15}{13} = \frac{24}{13} \times \frac{13}{15} = \frac{24}{15} = 1 \text{ hour } 36 \text{ minutes}$$

# PERMUTATION.

2.

$$1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11 \times 12 = 479001600 \text{ changes}$$

$$\text{days hrs. } 6,0) \overline{47900160}$$

$$365 \quad 6 = 8766) \overline{798336} (91 \text{ years}$$

$$78894$$

$$9396$$

$$8766$$

—days w. d.

$$24) 630 (26 = 3 \quad 5$$

$$48$$

$$150$$

$$144$$

6 hours

Ans. 91 years 3 weeks 5 days 6 hours

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$$3. \quad 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 = 5040 \text{ days.}$$

Then,  $5040 \div 365 = 13 \text{ years } 295 \text{ days}$

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$$4. \quad 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 = 362880$$

$$5. \quad 1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11 \times 12 \times 13 \times 14 \times 15 \\ \times 16 \times 17 \times 18 \times 19 \times 20 \times 21 \times 22 \times 23 \times 24 \times 25 \times 26 = \\ 403291461126605635584000000$$

## COMBINATION.

$$2. \quad \frac{\overset{4}{24} \times \overset{11}{23} \times \overset{7}{22} \times \overset{4}{21} \times \overset{4}{20} \times 19}{1 \times 2 \times 3 \times 4 \times 5 \times 6} = \\ 4 \times 23 \times 11 \times 7 \times 19 = 134596$$

$$3. \quad \frac{\overset{5}{30} \times \overset{4}{29} \times \overset{13}{28} \times \overset{5}{27} \times \overset{3}{26} \times \overset{5}{25} \times \overset{3}{24} \times 23}{1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8} = \\ 5 \times 29 \times 27 \times 13 \times 5 \times 23 = 5852925$$

## ADDITION OF DUODECIMALS.

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$$2. \quad \begin{array}{r} \text{feet.} \quad \text{in.} \quad " \quad "' \quad "" \\ 3780 \quad 9 \quad 4 \quad 7 \quad 9 \end{array}$$

## SUBTRACTION OF DUODECIMALS.

Page 154.

$$2. \quad 916 \text{ feet } 8 \text{ inches } 1 \text{ second } 8 \text{ thirds } 2 \text{ fourths}$$

$$3. \quad \begin{array}{r} \text{feet} \quad \text{in.} \quad " \quad "' \\ \text{From } 35 \quad 9 \quad 2 \quad 0 \\ \text{Take } 24 \quad 10 \quad 5 \quad 4 \\ \hline \text{Diff. } 10 \quad 10 \quad 8 \quad 8 \end{array}$$

$$4. \quad \begin{array}{r} \text{feet in.} \quad " \quad "' \quad "" \\ \text{From } 803 \quad 3 \quad 4 \quad 0 \quad 0 \\ \text{Take } 70 \quad 3 \quad 7 \quad 10 \quad 5 \\ \hline \text{Diff. } 732 \quad 11 \quad 8 \quad 1 \quad 8 \end{array}$$

## MULTIPLICATION OF DUODECIMALS.

Case 1. Page 155.

$$\begin{array}{r}
 \text{2.} \quad \text{ft. in.} \\
 \quad 9 \ 5 \\
 \quad \quad 3 \ 11 \\
 \hline
 \quad 8 \ 7 \ 7 \\
 28 \ 3 \\
 \hline
 \end{array}$$

square ft. 36 10 7

$$\begin{array}{r}
 \text{3.} \quad \text{ft. in.} \\
 \quad 7 \ 10 \\
 \quad \quad 8 \ 11 \\
 \hline
 \quad 7 \ 2 \ 2 \\
 62 \ 8 \\
 \hline
 \end{array}$$

sq. ft. 69 10 2

$$\begin{array}{r}
 \text{4.} \quad \text{ft. in. " } \\
 \quad 8 \ 4 \ 6 \\
 \quad \quad 2 \ 7 \ 4 \\
 \hline
 \quad \quad 2 \ 9 \ 6 \\
 \quad 4 \ 10 \ 7 \ 6 \\
 16 \ 9 \ 0 \\
 \hline
 \end{array}$$

square feet 21 10 5 0

$$\begin{array}{r}
 \text{5.} \quad \text{feet in.} \\
 \quad 5 \ 7 \\
 \quad \quad 1 \ 10 \\
 \hline
 \quad 4 \ 7 \ 10 \\
 \quad 5 \ 7 \\
 \hline
 \end{array}$$

square ft. 10 2 10

Then, 150 cents  
10 square feet

$$\begin{array}{r|l}
 2 \text{ in.} & \frac{1}{6} \frac{1}{3} \\
 8 \text{ " } & \frac{1}{4} \\
 2 \text{ " } & \\
 \hline
 & 1500 \\
 & 25 \\
 & 8 \frac{1}{3} \\
 & 2 \frac{1}{12} \\
 \hline
 \end{array}$$

\$15,35\frac{5}{12}

$$\begin{array}{r}
 \text{6.} \quad \text{ft. in.} \\
 \quad 7 \ 10 \\
 \quad 6 \ 8 \\
 \quad 5 \ 4 \\
 \hline
 19 \ 10 \\
 \quad 3 \ 11 \\
 \hline
 18 \ 2 \ 2 \\
 59 \ 6 \\
 \hline
 77 \ 8 \ 2 \\
 \quad 3 \\
 \hline
 \end{array}$$

233 0 6 square feet

Then, 233 square feet  
14 cents

$$\begin{array}{r}
 \text{" } \\
 \text{6 is } \frac{1}{24} = \frac{7}{12} \\
 \hline
 3262 \\
 \hline
 \$32,62\frac{7}{12}
 \end{array}$$

Case 2. Page 156.

2.	<i>ft. in.</i> 76 7 $\times 1$ 6	3.	<i>ft. in.</i> 127 6 $\times 2$ 10	4.	<i>ft. in.</i> 184 8 $\times 7$ 12
	<hr/> 459 6 3		<hr/> 1275 0 9		<hr/> 2216 0 10
	<hr/> 1378 6		<hr/> 11475 0		<hr/> 22160 0
<i>in.</i>	76 7	<i>in.</i>	255 0	<i>in.</i>	1292 8
6 is $\frac{1}{2}$ =	38 3 6	4 is $\frac{1}{3}$ =	42 6	6 is $\frac{1}{2}$ =	92 4
4 ' $\frac{1}{3}$ =	25 6 4		<hr/> 11772 6		<hr/> sq. feet 23545 0
sq. ft.	1518 10 10				

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6.	<i>feet in.</i> 38 11 10	7.	<i>feet in.</i> 59 9 4
	<hr/> 389 2 7		<hr/> 239 0 6
	<hr/> 2724 2		<hr/> 1434 0
6 in. is $\frac{1}{2}$ =	19 5 6	6 in. is $\frac{1}{2}$ =	29 10 $\frac{1}{2}$
2 ' ' $\frac{1}{3}$ =	6 5 10		<hr/> 9)1463 10 $\frac{1}{2}$
square feet	2750 1 4		<hr/> 162 yds. 5 ft. 10 $\frac{1}{2}$ in.
8.	<i>feet in. feet</i> 54 9 = 54,75 58 6 = 58,5	9.	<i>feet in.</i> 7 6 3 3
	<hr/> 27375 43800 27375		<hr/> 1 10 6 22 6
	<hr/> 9)3202,875		<hr/> 24 4 6 1 10
	<hr/> 355,875 yards 15 cents		<hr/> 20 3 9 0 24 4 6
	<hr/> \$53,38125		<hr/> square feet 44 8 3 0



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$$\begin{array}{rcl}
 10. & \begin{array}{l} \text{ft. in.} \\ (2 \ 10) \end{array} \times \begin{array}{l} \text{ft. in.} \\ (2 \ 4) \end{array} \times \begin{array}{l} \text{ft. in.} \\ (1 \ 9) \end{array} = & \begin{array}{l} \text{ft. in.} \\ 11 \ 6 \ 10 \end{array} \\
 & \begin{array}{l} (2 \ 10) \end{array} \times \begin{array}{l} (2 \ 6) \end{array} \times \begin{array}{l} (1 \ 3) \end{array} = & \begin{array}{l} 8 \ 10 \ 3 \end{array} \\
 & \begin{array}{l} (3 \ 6) \end{array} \times \begin{array}{l} (2 \ 2) \end{array} \times \begin{array}{l} (1 \ 8) \end{array} = & \begin{array}{l} 12 \ 7 \ 8 \end{array} \\
 & \begin{array}{l} (2 \ 10) \end{array} \times \begin{array}{l} (2 \ 8) \end{array} \times \begin{array}{l} (1 \ 9) \end{array} = & \begin{array}{l} 13 \ 2 \ 8 \end{array} \\
 & \begin{array}{l} (2 \ 10) \end{array} \times \begin{array}{l} (2 \ 6) \end{array} \times \begin{array}{l} (1 \ 9) \end{array} = & \begin{array}{l} 12 \ 4 \ 9 \text{ '''} \end{array} \\
 & \begin{array}{l} (2 \ 11) \end{array} \times \begin{array}{l} (2 \ 8) \end{array} \times \begin{array}{l} (1 \ 8) \end{array} = & \begin{array}{l} 12 \ 11 \ 6 \ 8 \end{array} \\
 & & \hline
 & & \begin{array}{l} 71 \ 7 \ 8 \ 8 \end{array}
 \end{array}$$

Or, 71,6435 square feet

Then, as  $\begin{array}{l} \text{ft.} \\ 40 \end{array} : \begin{array}{l} \text{dolls.} \\ 20 \end{array} \therefore \begin{array}{l} \text{sq. feet} \\ 2 \end{array} : 1 :: 71,6435 : \$35,82 +$

*To find a ship's tonnage.*

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$$3. \quad \frac{64 \times 22 \times 10}{95} = 1\frac{4080}{95} = 148\frac{4}{19} \text{ tons}$$

$$4. \quad \frac{80 \times 26 \times 13}{95} = 2\frac{7040}{95} = 284\frac{12}{19} \text{ tons}$$

**THE CARPENTERS' OR SLIDING RULE.**

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*1st. To multiply numbers together.*

2. Set 1 on B to 12 on A, then against 16 on B stands 192 the product on A.

3. Set 1 on B to 35 on A, then against 19 on B stands 665 the product on A.

4. Set 1 on B to 54 on A, then against 270 on B stands 14580 the product on A.

*2d. Division of numbers by the Carpenter's rule.*

2. Set the divisor 19 on B to the dividend 665 on A, then against 1 on B stands 35 the quotient on A.

3. Set 27 on B to 396 on A, then against 1 on B stands 14,6 the quotient on A.

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4. Set 42 on B to 741 on A, then against 1 on B stands 17,6 the quotient on A.

5. Set 24 on B to 7680 on A, then against 1 on B stands 320 the quotient on A.

3d. *To square numbers by the Carpenters' rule.*

Page 161.

2. Having set 1 on C to 10 on D, then against 30 on D stands 900 on C.

3. Having the rule set as above, against 35 on D you will find 1225 its square on C.

4. Also against 40 on D stands 1600 its square on C.

4th. *To find a fourth proportional to three numbers.*

2. Set the first term 25 on B to 75 the second term on A, then against 100 the third term on B stands 300 the fourth term on A.

3. Set 27 on B to 20 on A, then against 73 on B stands  $54\frac{2}{7}$  on A.

5th. *To extract the square root of any number by the Carpenters' rule.*

2. Having set 1 on C to 10 on D, against 529 on C stands 23 its root on D.

3. Being set as in the last example, against 900 on C stands 30 the root on D.

4. The rule set as before, against 300 on C stands 17,3 the root on D.

## MEASURING OF BOARDS AND TIMBER.

Page 162.

1st. *To find the superficial content of a board or plank.*

$$\begin{array}{r}
 \text{foot in.} \\
 2. \quad \begin{array}{r} 1 \quad 2 \\ \phantom{1} 12 \quad 6 \\ \hline \phantom{1} 7 \quad 0 \\ \phantom{1} 14 \quad 0 \\ \hline \end{array} \\
 \text{feet } 14 \quad 7
 \end{array}$$

Or by the sliding rule.

As 12 on B : 14 on A ::  
 12 ft. 6 in. on B : 14 ft.  
 7 in. on A.\*

$$3. \quad 13\frac{1}{2} + 13\frac{1}{2} + 14\frac{1}{2} + 18 + 11\frac{1}{4} = 70\frac{3}{4} = 28\frac{3}{4} \text{ inches}$$

$$\text{But } 28\frac{3}{4} \text{ inches} = \frac{283}{4 \times 12} \text{ feet } 28\frac{3}{8} \text{ feet}$$

$$\text{And } 17\frac{1}{2} \text{ feet} = 3\frac{5}{2} \text{ feet}$$

$$\text{Then, } \frac{283}{48} \times 3\frac{5}{2} \times 3 \text{ cts.} = \frac{9905 \times 3}{96} = \frac{9905}{32} = 3\text{d. } 09\frac{17}{32} \text{ cts.}$$

2d. *Having the breadth of a board or plank in inches, to find how much in length will make a foot, &c.*

Page 163.

$$2. \quad 144 \div 23 = 6,26 \text{ inches}$$

$$3. \quad 1\frac{1}{2} \text{ yards} = 1944 \text{ square inches}$$

$$\text{Then, } 1944 \div 26 = 74,7692 \text{ inches} = 6,2307 \text{ feet}$$

3d. *To find the solid content of square or four sided timber.*

Page 164.

$$2. \quad \frac{15 \text{ in.} \times 15 \text{ in.} \times 18 \text{ ft.}}{144} = 2\frac{25}{8} = 28\frac{1}{8} \text{ feet}$$

$$3. \quad \frac{25 \text{ in.} + 9 \text{ in.}}{2} = 17 \text{ inches the quarter girt}$$

$$\text{Then, } \frac{17 \text{ in.} \times 17 \text{ in.} \times 20 \text{ ft.}}{144} = 40,1388 \text{ feet, \&c.}$$

\* The operation by the sliding rule is omitted after this, it being presumed that the directions in the W. Calculator make it superfluous to work more examples.

Page 164.

$$4. \quad \frac{32\text{in.} + 10\text{in.}}{2} = 21 \text{ inches the mean breadth}$$

$$\text{And } \frac{20\text{in.} + 6\text{in.}}{2} = 13 \text{ inches the mean breadth}$$

$$\text{Then, } \frac{21 \times 13 \times 18}{8} = 27\frac{3}{8} = 34,125 \text{ feet}$$

4th. *To find the solid content of round timber.*

Page, 165.

$$2. \quad \frac{14 + 2}{2 \times 4} = 2 \text{ the quarter girt}$$

$$\text{Then, } 2 \times 2 \times 24 = 96 \text{ feet.}$$

Page 166.

$$3. \quad 24 \text{ inches} = 2 \text{ feet}$$

$$\text{Then, } 2 \text{ feet} \times 2 \text{ feet} \times 18 \text{ feet} = 72 \text{ feet.}$$

$$4. \quad \frac{11 \text{ ft. } 4 \text{ in.} + 2 \text{ ft. } 8 \text{ in.}}{2 \times 4} = 1\frac{4}{8} = 1,75 \text{ feet}$$

$$\text{Then, } 1,75 \text{ ft.} \times 1,75 \text{ ft.} \times 21 \text{ ft.} = 64,3125 \text{ feet}$$

$$\begin{aligned} 5. \quad 24 \times \left(\frac{8}{4}\right)^2 &= 24 \times 4 && = 96 \\ 14\frac{1}{2} \times \left(\frac{3\frac{1}{2}}{4}\right)^2 &= 14,5 \times 6,2015625 && = 8,9922 + \\ 17\frac{1}{4} \times \left(\frac{6\frac{3}{4}}{4}\right)^2 &= 17,25 \times 2,4649 && = 42,5195 \end{aligned}$$

---

sum 147,5117 feet

## CARPENTERS' AND JOINERS' WORK.

Page 168.

$$2. \quad \frac{(53\text{ft. } 6\text{in.}) \times (47\text{ft. } 9\text{in.})}{100} = \frac{53,5 \times 47,75}{100} = 25 \frac{\text{sq. feet}}{54,625}$$

$$3. \quad \frac{(36\text{ft. } 3\text{in.}) \times (16\text{ft. } 6\text{in.})}{100} = \frac{36,25 \times 16,5}{100} = 5,98125 \text{ squares}$$

$$\text{Then, } 5,98125 \text{ squares} \times 4 \text{ d. } 50 \text{ c.} = 26 \text{ d. } 91 \text{ c. } 5,625 \text{ m.}$$

Page 168.

4.  $35 \text{ ft.} \times 30 \text{ ft.} = 1050 \text{ square feet}$   
 $(4 \text{ ft. } 6 \text{ in.}) \times 6 \text{ ft.} = 4,5 \times 6 = 27 \text{ square ft. fire place}$   
 $(10 \text{ ft. } 6 \text{ in.}) \times 8 \text{ ft.} = 10,5 \times 8 = 84 \text{ ' ' stairs}$   


---

111 feet

Then,  $\frac{1050 - 111}{100} = 9,39 \text{ squares}$

Lastly,  $9,39 \text{ squares} \times 3 \text{ d. } 75 \text{ c.} = 35 \text{ d. } 21 \text{ c. } 2,5 \text{ ms.}$

$$5. \quad \begin{array}{c} \text{ft. in.} \\ (82 \ 6) \end{array} \times \begin{array}{c} \text{ft. in.} \\ (12 \ 3) \end{array} = \frac{82,5 \times 12\frac{1}{4}}{100} = 10 \ 10,625$$

$$6. \quad \frac{(91 \text{ ft. } 9 \text{ in.}) \times (11 \text{ ft. } 3 \text{ in.})}{100} = \frac{91,75 \times 11\frac{1}{4}}{100} = 10,321875 \text{ squares}$$

Then,  $\begin{array}{ccccc} \text{squares} & \text{dolls.} & \text{cts.} & \text{d.} & \text{cts.} & \text{mills} \\ 10,321875 \times 4 & 50 & = & 46 & 44 & 8,4375 \end{array}$

Page 169.

$$8. \quad \begin{array}{c} \text{ft. in.} \\ 2 \overline{) 30 \ 6} \\ \underline{15 \ 3} \end{array}$$

$45 \ 9 = 45,75 \text{ feet.}$  And  $52 \text{ feet } 8 \text{ in.} = 52\frac{2}{3} \text{ feet}$

Then,  $\frac{45,75 \times 52\frac{2}{3}}{100} = 24,095 \text{ squares}$

Lastly,  $24,095 \text{ sq.} \times 140 \text{ cts.} = 33 \text{ dolls. } 73 \text{ cts. } 3 \text{ mills}$

$$9. \quad \begin{array}{c} \text{ft. in.} \\ 20 \ 6 \\ \frac{1}{2} = 10 \ 3 \end{array}$$

$30 \ 9 = 30,75 \text{ feet.}$  And  $40 \text{ feet } 6 \text{ inches} = 40,5 \text{ feet}$

Then,  $\frac{30,75 \times 40,5}{100} = 12,45375 \text{ squares}$

Lastly,  $12,45375 \text{ squares} \times 225 \text{ cts.} = 28 \text{ dollars } 2 \text{ cents } +$

Page 170.

$$11. \quad (137 \text{ ft. } 6 \text{ in.}) \times (16 \text{ ft. } 3 \text{ in.}) = 137,5 \times 16\frac{1}{4} = 2234,375 \text{ square feet}$$

Then,  $2234,375 \text{ feet} \div 9 = 248 \text{ yards } 2,375 \text{ feet}$

Page 170.

$$12. \quad (69 \text{ ft. } 9 \text{ in.}) \times (6 \text{ ft. } 3 \text{ in.}) = 69,75 \times 6\frac{1}{4} = 435,9375$$

$$\frac{1}{2} \text{ work} = 217,96875$$

$$\underline{9)653,90625}$$

square yards 72,65625

$$13. \quad (83 \text{ ft. } 8 \text{ in.}) \times (12 \text{ ft. } 6 \text{ in.}) = 83\frac{2}{3} \times 12,5 = 1045,83\frac{1}{3}$$

$$(7 \text{ ft. } 8 \text{ in.}) \times (2 \text{ ft. } 6 \text{ in.}) \times 1\frac{1}{2} = 7\frac{2}{3} \times 2,5 \times 1,5 = 28,75 \text{ wind.}$$

$$(3 \text{ ft. } 6 \text{ in.}) \times 7 \text{ ft.} \times \frac{1}{2} = 3,5 \times 7 \times ,5 = 12,25 \text{ door}$$

$$\underline{9)1086,83\frac{1}{3}}$$

square yards 120,7 $\frac{16}{27}$ 

$$\text{Then, } 120,7\frac{16}{27} \text{ yds.} \times 80 \text{ cts.} = 96 \text{ dolls. } 60 \text{ cts. } 7\frac{11}{27} \text{ mills}$$

## BRICKLAYERS' WORK.

Page 173.

$$\text{ft. in.} \quad \text{ft. in.} \quad \text{half brick}$$

$$2. \quad (57 \ 3) \times (24 \ 6) \times 5 = 57,25 \times 24,5 \times 5 = 7013,125$$

$$\text{Then, } 3)7013,125$$

$$\underline{9)2337,708\frac{1}{3}} \text{ standard thickness}$$

$$259,745 + \text{square yards}$$

$$\text{Or, } 2337,708\frac{1}{3} \div 272\frac{1}{4} = 8,5866 \text{ rods}$$

$$3. \quad \text{ft. in.} \quad \text{ft. in.}$$

$$(245 \ 9) \times (16 \ 6) \times 5 = 245,75 \times 16,5 \times 5 = 20274,375$$

$$\text{And } 20274,375 \div 3 = 6758,125 \text{ standard thickness}$$

$$\text{Then, } \frac{6758,125}{272,25} = 24 \text{ rods } 3 \text{ quarters } 19,945 \text{ feet}$$

$$4. \quad (45 \text{ ft.} \times \frac{15}{2} \text{ ft.} \times 5) \div 3 = 562,5 \text{ standard thickness}$$

$$\text{Then, } 562,5 \div 272,25 = 2 \text{ rods } 18 \text{ feet}$$

## MASONS' WORK.

Page 175.

$$\text{ft. in.} \quad \text{ft. in.}$$

$$2. \quad (53 \ 6) \times (12 \ 3) \times 2 = 53,5 \times 12\frac{1}{4} \times 2 = 1310,75 \text{ feet}$$

$$\text{Then, } 1310,75 \div 24,75 = 52,9595 \text{ rods}$$

Page 175.

$$3. (107 \text{ ft. } 9 \text{ in.}) \times (20 \text{ ft. } 6 \text{ in.}) = 2208 \text{ feet } 10\frac{1}{2} \text{ inches}$$

$$4. \frac{(112 \text{ ft. } 3 \text{ in.}) \times (16 \text{ ft. } 6 \text{ in.})}{63} = \frac{112,25 \times 16,5}{63} = 29 \frac{25,125}{63} \text{ rods feet}$$

$$5. (5 \text{ ft. } 7 \text{ in.}) \times (1 \text{ ft. } 10 \text{ in.}) = \frac{67}{12} \times \frac{22}{12} = \frac{1474}{144} = \frac{737}{72} \text{ feet}$$

$$\text{Then, } \frac{737}{72} \times 80 \text{ cts.} = \frac{737 \times 10}{9} = 818\frac{8}{9} \text{ cts.} = 8 \text{ dolls. } 18\frac{8}{9} \text{ cts.}$$

## PLASTERERS' WORK.

Page 177.

$$2. \frac{\begin{smallmatrix} \text{feet} & \text{in.} \\ (141 & 6) \end{smallmatrix} \times \begin{smallmatrix} \text{feet} & \text{in.} \\ (11 & 3) \end{smallmatrix}}{9} = \frac{141,5 \times 11,25}{9} = 176,875 \text{ yards}$$

$$3. (22 \text{ ft. } 7 \text{ in.}) \times (13 \text{ ft. } 11 \text{ in.}) = \frac{271}{12} \times \frac{167}{12} = \frac{45257}{144} \text{ feet}$$

$$\text{But, } \frac{45257}{144} \text{ feet} = \frac{45257}{144 \times 9} = \frac{45257}{1296} \text{ yards}$$

$$\text{Then, } \frac{45257}{1296} \times 15 \text{ cts.} = \frac{226285}{432} = 5 \text{ dolls. } 23 \text{ cts. } 8\frac{17}{216} \text{ ms.}$$

$$4. (20 \text{ ft. } + 14 \text{ ft. } 6 \text{ in.}) \times 2 = 69 \text{ feet round the room}$$

$$69 \text{ ft.} \times (10 \text{ ft. } 4 \text{ in.}) = 713 \text{ sq. feet in the walls}$$

$$(4 \text{ ft. } 4 \text{ in.}) \times 4 \text{ ft.} = 17 \text{ ft. } 4 \text{ inches fire place}$$

$$(3 \text{ ft. } 2 \text{ in.}) \times 6 \text{ ft.} \times 2 = 38 \text{ ft. } 0 \text{ ' two windows}$$

$$\text{Sum } 55 \text{ ft. } 4 \text{ in.} = 55\frac{1}{3} \text{ feet}$$

$$713 \text{ ft.} - 55\frac{1}{3} = 657\frac{2}{3}$$

$$\text{Lastly, } 657\frac{2}{3} \div 9 = 73\frac{2}{27}$$

$$5. (14 \text{ ft. } 5 \text{ in.} + 13 \text{ ft. } 2 \text{ in.}) \times 2 = 55 \text{ ft. } 2 \text{ inches round}$$

$$\text{Then, } (55 \text{ ft. } 2 \text{ in.}) \times (9 \text{ ft. } 3 \text{ in.}) = 510 \text{ } 3 \text{ } 6 \text{ ft. in. ''}$$

$$7 \text{ ft.} \times 4 \text{ ft.} = 28 \text{ } 0 \text{ } 0$$

$$\begin{array}{r} 9 \overline{)482 \text{ } 3 \text{ } 6} \end{array}$$

Rendering 53 y. 5 ft. 3 in. 6 s.

$$\begin{array}{r} \text{ft. in.} \quad \text{in.} \quad \text{ft. in.} \\ 14 \text{ } 5 \text{ less } 10 = 13 \text{ } 7 \end{array} \text{ And } 13 \text{ ft. } 2 \text{ in.} - 10 \text{ in.} = 12 \text{ ft. } 4 \text{ in.}$$

$$\text{Then, } \frac{(13 \text{ ft. } 7 \text{ in.}) \times (12 \text{ ft. } 4 \text{ in.})}{9 \text{ feet}} = 18 \text{ yds. } 5 \text{ ft. } 6 \text{ in. } 4''$$

Page 177.

$$6. \frac{\begin{array}{c} \text{feet. in.} \quad \text{feet in.} \\ (105 \ 6) \times (275 \ 5) \end{array}}{9 \text{ feet}} = \frac{105,5 \times 275 \frac{5}{12}}{9} = \frac{\text{square yards}}{108} = 3228,4 \frac{103}{108}$$

Then,  $3228,4 \frac{103}{108}$  sq. yds.  $\times 12$  cts. = 387 d. 41 c.  $9 \frac{4}{9}$  m.

$$7. \begin{array}{l} (30 \text{ ft. } 6 \text{ in.} + 24 \text{ ft. } 9 \text{ in.}) \times 2 = 110 \ 6 = 110,5 \text{ round} \\ 110,5 \text{ ft.} \times 10 \text{ ft.} = 1105 \text{ square feet in the walls} \\ 30,5 \text{ ' } \times 24 \frac{3}{4} \text{ ' } = 754,875 \text{ in the ceiling} \end{array}$$

---


$$9)1859,875$$


---

$$206,652 \frac{7}{9} \text{ square yards}$$

$$2 \text{ cents}$$


---

$$\$4,13305 \frac{5}{9}$$

Or, 4 dollars 13 cents 3 mills.

## PAVERS' WORK.

Page 178.

$$2. \frac{(35 \text{ ft. } 4 \text{ in.}) \times (8 \text{ ft. } 3 \text{ in.})}{9} = \frac{35 \frac{1}{3} \times 8,25}{9} = \frac{\text{square yards}}{9} = 32,3 \frac{8}{9}$$

Then,  $32,3 \frac{8}{9}$  sq. yds.  $\times 28$  cts. = 9 dolls. 06 cts.  $8 \frac{8}{9}$  mills

$$3. \begin{array}{l} (27 \text{ ft. } 10 \text{ in.}) \times (14 \text{ ft. } 9 \text{ in.}) = 27 \frac{5}{6} \times 14,75 = 410,54 \frac{1}{6} \text{ s. f.} \\ 410,54 \frac{1}{6} \div 9 = 45,61 \frac{31}{54} \text{ square yards} \end{array}$$

Then,  $45,61 \frac{31}{54} \times 38$  cts. = 1733,39  $\frac{22}{27}$  cts. = 17 33 3,9 +

$$4. \ 45 \text{ feet} - 5 \text{ feet } 3 \text{ inches} = 39 \text{ feet } 9 \text{ inches}$$

$$\frac{63 \text{ ft.} \times (5 \text{ ft. } 3 \text{ in.})}{9} = 7 \times 5 \frac{1}{4} \text{ feet} = 36 \frac{3}{4} \text{ sq. yds. broad stones}$$

$$\frac{63 \text{ ft.} \times (39 \text{ ft. } 9 \text{ in.})}{9} = 7 \times 39 \frac{3}{4} \text{ ft.} = 278 \frac{1}{4} \text{ sq. yds. pebbles}$$

$$\begin{array}{l} \text{Then, } 36 \frac{3}{4} \text{ square yards} \times 36 \text{ cts.} = 13 \ 28 \\ 278 \frac{1}{4} \text{ ' } \times 30 \text{ ' } = 83 \ 47 \frac{1}{2} \end{array}$$

---


$$\text{Sum } \$96 \ 70 \frac{1}{2}$$



## PAINTERS' WORK.

Page 179.

$$\begin{array}{rcl}
 2. & (74 \text{ ft. } 10 \text{ in.}) \times (11 \text{ ft. } 7 \text{ in.}) = & \begin{array}{r} \text{ft.} \quad \text{in.} \quad \text{''} \\ 866 \quad 9 \quad 10 \end{array} \\
 & (7 \text{ ft. } 6 \text{ in.}) \times (3 \text{ ft. } 9 \text{ in.}) = & 28 \quad 1 \quad 6 \text{ door} \\
 & (6 \text{ ft. } 8 \text{ in.}) \times (3 \text{ ft. } 4 \text{ in.}) \times 5 = & 111 \quad 1 \quad 4 \text{ windows} \\
 & (22 \text{ ft. } 8 \text{ in.}) \times (1 \text{ ft. } 2 \text{ in.}) \times 5 = & 132 \quad 2 \quad 8 \text{ breaks}
 \end{array}$$

$$\begin{array}{rcl}
 & & \underline{\hspace{1cm}} \quad \underline{\hspace{1cm}} \\
 & & 1138 \quad 3 \quad 4 \\
 & (6 \text{ ft. } 9 \text{ in.}) \times 5 \text{ feet} = & 33 \quad 9 \quad 0 \text{ chimney} \\
 & & \underline{\hspace{1cm}} \quad \underline{\hspace{1cm}} \quad \text{feet} \\
 & & 1104 \quad 6 \quad 4 = 1104 \frac{19}{36}
 \end{array}$$

And  $1104 \frac{19}{36} \div 9 = 122 \frac{235}{24}$  square yardsThen,  $122 \frac{235}{24} \text{ s. yds.} \times 8 \frac{1}{2} \text{ cts.} = 10 \text{ dolls. } 43 \text{ cts. } 12 \frac{11}{24} \text{ ms.}$ 

$$\begin{array}{rcl}
 3. & (20 \text{ ft. } + 14 \text{ ft. } 6 \text{ in.}) \times 2 = & 69 \text{ feet round} \\
 & 69 \text{ ft.} \times (10 \text{ ft. } 4 \text{ in.}) = 69 \times 10 \frac{1}{3} = & 713 \text{ square feet} \\
 & (4 \text{ ft. } 4 \text{ in.}) \times 4 \text{ ft.} = 4 \frac{1}{3} \times 4 = & 17 \frac{1}{3} \text{ feet fire place} \\
 & (3 \text{ ft. } 2 \text{ in.}) \times 6 \text{ ft.} \times 2 = 3 \frac{1}{6} \times 6 \times 2 = & 38 \text{ feet windows}
 \end{array}$$

Sum  $55 \frac{1}{3}$ 

$$\text{Then, } \frac{713 - 55 \frac{1}{3}}{9} = \frac{657 \frac{2}{3}}{9} = 73 \frac{2}{27} \text{ square yards.}^*$$

Page 180.

$$\begin{array}{rcl}
 4. & (24 \frac{1}{2} \text{ ft. } + 16 \frac{1}{4} \text{ ft.}) \times 2 \times 12 \frac{3}{4} \text{ ft.} = & \begin{array}{r} \text{ft.} \quad \text{in.} \quad \text{''} \\ 1039 \quad 1 \quad 6 \end{array} \\
 & (3 \text{ ft. } 6 \text{ in.}) \times 7 \text{ feet} = & 24 \quad 6 \quad 0 \text{ door} \\
 & (7 \text{ ft. } 9 \text{ in.}) \times (3 \text{ ft. } 6 \text{ in.}) \times 2 = & 54 \quad 3 \quad 0 \text{ w. shut.} \\
 & 24 \text{ ft.} \times (1 \text{ ft. } 3 \text{ in.}) \times 2 = & 60 \quad 0 \quad 0 \text{ breaks}
 \end{array}$$

$$\begin{array}{rcl}
 & & \underline{\hspace{1cm}} \quad \underline{\hspace{1cm}} \\
 & & 1177 \quad 10 \quad 6 \\
 & (5 \text{ ft. } 6 \text{ in.}) \times 5 \text{ feet} = & 27 \quad 6 \quad 0
 \end{array}$$

$$\underline{\hspace{1cm}} \quad \underline{\hspace{1cm}} \quad \underline{\hspace{1cm}}$$

$$1150 \quad 4 \quad 6$$

$$9 \overline{)1150 \frac{3}{8}}$$

$$\underline{\hspace{1cm}} \quad \underline{\hspace{1cm}} \quad \underline{\hspace{1cm}}$$

$$127 \frac{59}{72}$$

Then,  $127 \frac{59}{72} \times 6 \text{ cts.} = 7 \text{ dolls. } 66 \text{ cts. } 9 \frac{1}{6} \text{ ms.}$ 

\* The same as question 4, plasterers' work.

## GLAZIERS' WORK.

Page 181.

$$2. \quad (7 \text{ ft. } 3 \text{ in.}) \times (3 \text{ ft. } 5 \text{ in.}) = 24 \text{ square feet } 9 \text{ in. } 3 \text{ sec.}$$

$$3. \quad (6 \text{ ft. } 11 \text{ in.} + 5 \text{ ft. } 4 \text{ in.} + 4 \text{ ft. } 3 \text{ in.}) \times (3 \text{ ft. } 6 \text{ in.}) \times 7 = 16,5 \times 3,5 \times 7 = 404,25 \text{ square feet}$$

$$\text{Then, } 404,25 \text{ sq. ft.} \times 14\frac{1}{2} \text{ cts.} = 58 \text{ d. } 61 \text{ cts. } 6,25 \text{ ms.}$$

$$4. \quad (12 \text{ ft. } 6 \text{ in.}) \times \left( \frac{16 \text{ ft. } 9 \text{ in.}}{2} \right) = 12,5 \times 8,375 = 104,6875 \text{ square feet.}$$

$$\text{Then, } 104,6875 \text{ sq. ft.} \times 10 \text{ cts.} = 10 \text{ d. } 46 \text{ cts. } 8\frac{3}{4} \text{ ms.}$$

$$5. \quad (14 \text{ ft. } 6 \text{ in.}) \times (4 \text{ ft. } 9 \text{ in.}) = 68 \text{ sq. ft. } 10 \text{ in. } 6 \text{ sec.}$$

$$6. \quad (7 \text{ ft. } 10 \text{ in.} + 6 \text{ ft. } 8 \text{ in.} + 5 \text{ ft. } 4 \text{ in.}) \times (3 \text{ ft. } 11 \text{ in.}) \times 9 =$$

$$19\frac{5}{8} \times 3\frac{11}{12} \times 9 = \frac{119}{\cancel{6}} \times \frac{47}{\cancel{12}} \times \cancel{9} = 5\frac{59}{8} = 699\frac{1}{8} \text{ square feet}$$

$$\text{Then, } 699\frac{1}{8} \text{ square feet} \times 14 \text{ cents} = 97 \text{ dollars } 87\frac{3}{4} \text{ cents}$$

## MEASUREMENT OF GROUND.

1st. *To find the content of a square piece of ground.*

Page 182.

$$2. \quad 35 \times 2 = 70 \text{ perches.}$$

$$\text{Then, } 70 \times 70 = 4900 \text{ square feet} = 30 \text{ A. } 2 \text{ R. } 20 \text{ P.}$$

$$3. \quad 16\frac{1}{2} \times 16\frac{1}{2} = 16,5 \times 16,5 = 272,25 = 1 \text{ sq. perches } 2 \text{ A. } 32\frac{1}{4} \text{ P.}$$

2d. *To find the content of an oblong piece of ground, called a parallelogram.*

Page 183.

$$\frac{120 \text{ perches} \times 84 \text{ perches}}{160 \text{ perches}} = 63 \text{ acres}$$

Page 183.

$$3. \quad \frac{240 \times 120}{16\frac{1}{3} \times 16\frac{1}{2}} = \frac{28800}{272\frac{1}{4}} = 105 \text{ perches } 213\frac{3}{4} \text{ feet}$$

But, 105 per.  $213\frac{3}{4} = 2$  rods 25 perches  $213\frac{1}{4}$  feet.

3d. *To find the content of a triangular piece of ground.*

Page 184.

2.  $75 \times \frac{5}{2} = 75 \times 25 = 1875$  per. = 11 A. 2 R. 35 P.

3.  $120 \times \frac{84}{2} = 120 \times 42 = 5040$  per. = 31 acres 2 roods  
*A. R. dolls.* *dolls. cts.*

Then,  $(31\ 2) \times 45 = 31,5 \times 45 = 1417\ 50$

4.  $140 \text{ ft.} \times 7\frac{0}{2} \text{ ft.} = 140 \times 35 = 4900 \text{ square feet.}$

Then  $4900 \div 9 = 544$  yards 4 feet.

4th. *To find the content of a piece of ground, in the form of an oblique parallelogram.*

Page 185.

2.  $(80 \times 24) \div 160 = 12$  acres

5th. *To find the content of a piece of ground bounded by four sides, none of which are parallel or equal.*

Page 186.

$$2. \quad \frac{120 \times (48 + 24)}{2} = 4320 \text{ perches} = 27 \text{ acres}$$

6th. *To find the area of a piece of ground lying in a circle, or ellipsis.*

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2.  $30 \times 20 \times ,7854 = 471,24 = 2 \quad 3 \quad 31,24$  *perches A. R. P.*

3.  $160 \times 160 \times .7854 = 20106.24$  square feet

But,  $20106,24 \div 9 = 2234,02\frac{2}{3}$  square feet

## GAUGING.

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$$2. \quad 28 + \frac{2}{3} (24 - 18) = 18 + 4 = 22 \text{ mean diameter}$$

$$\text{Then, } \frac{22 \times 22 \times \overset{4}{24}}{\underset{49}{24}} = \frac{1936}{49} = 39\frac{25}{49} \text{ gallons}$$

$$3. \quad 28 + \frac{2}{3} (36 - 28) = 28 + 5\frac{1}{3} = 33\frac{1}{3} \text{ mean diameter}$$

$$\text{Then, } \frac{33\frac{1}{3} \times 33\frac{1}{3} \times 40}{294} = \frac{100 \times 100 \times \overset{20}{40}}{9 \times \underset{147}{24}} = \frac{200000}{1323} = 151\frac{227}{1323} \text{ gallons}$$

$$4. \quad 15 + \frac{2}{3} (18 - 15) = 15 + 2 = 17 \text{ mean diameter}$$

$$\text{Then, } \frac{17 \times 17 \times 29}{359} = \frac{8381}{359} = 23\frac{124}{359} \text{ gallons}$$

$$5. \quad 18 + \frac{2}{3} (22 - 18) = 18 + 2\frac{2}{3} = 20\frac{2}{3} \text{ mean diameter}$$

$$\text{Then, } \frac{20\frac{2}{3} \times 20\frac{2}{3} \times 36}{359} = \frac{62 \times 62 \times \overset{4}{36}}{\underset{359}{36}} = \frac{15376}{359} = 42\frac{298}{359} \text{ gallons}$$

## MECHANICAL POWERS.

## 1st. THE LEVER.

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As 1 inch : 20 inches :: 5 lb. : 100 pounds the answer

## 2d. THE WHEEL AND AXLE.

Page 191.

As 60 inches (=5 lb.) : 6 inches :: 10 lb. : 1 lb.

PROMISCUOUS QUESTIONS.

Page 192.

Quest. 1.  $2578 + 2578 = 5156$

2.  $14676 - 14\frac{6}{4}76 = 14676 - 3669 = 11007$

3.  $1468 - (461 + 581) = 1468 - 1042 = 426$

4.  $\frac{1}{3}$  of 100 cents  $= 33\frac{1}{3}$  cents  
 $\frac{1}{2}$  of  $\frac{1}{3} = \frac{1}{6}$  of 100 cts.  $= 16\frac{2}{3}$

Sum 50 cents

5.  $1080 \div 45 = 24$  the number required

6.  $(476)^2 \div 4\frac{7}{2}6 = 2\frac{2657}{238}6 = 952$

7. Suppose one side of the square to consist of 100 men

Then,  $100^2 + 231 = 10231$  the whole number of men

And  $101^2 - 44 = 10157$  the whole of the men

74 error too little

Again, suppose the side of the square to have 120 men

Then,  $120^2 + 231 = 14631$  the whole number of men

And  $121^2 - 44 = 14597$  the whole number of men

34 error too little

Errors alike.

Then,  $\frac{(120 \times 74) - (100 \times 34)}{74 - 34} = 5\frac{480}{40} = 137$  men on one side

Lastly,  $(137)^2 + 231$ , or  $(138)^2 - 44 = 19000$  men

8.  $113 \times 147 - 21^3 = 16611 - 9261 = 7350$

9.  $\frac{2}{3}$  of  $\frac{3}{8} = \frac{2}{8} = \frac{1}{4}$  then, as  $\frac{1}{4} : 1260 \text{ d.} :: 1 : 5040 \text{ dolls.}$

10.  $3500 - 2500 = 1000$  dollars

Then, 2500 dollars } dolls. { 100 dollars  
 8 years } 1000 { 1 year

40

Lastly,  $\frac{1000 \times 100}{2500 \times 8} = 5$  per cent.

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$$11. \text{ As } \frac{2}{3} : 210 :: 1 : \frac{210 \times 3}{2} = \$315 \text{ elder brother's por.}$$

$$\text{Now, } 315 \times 3 \times 2 = 1890 \text{ dollars}$$

$$12. (650 - 130) \times 400 = 520 \text{ d. } \times 4 \text{ dolls.} = 2080 \text{ dolls.}$$

$$13. 17 + 8 + 46 + (20 \times 2) = 111 \text{ years}$$

$$14. 1000 - (350 + 400) = 250 \text{ dollars C's share}$$

*dolls. dolls.**dolls. dolls.*Then, as 250 : 500  $\therefore$  as 1 : 2 :: 350 : 700 A put in

And, as 1 : 2 :: 400 dolls. : 800 dolls. B's cloth is worth

$$15. \frac{1}{5} \text{ of } 2720 = 544 \text{ dollars the captain's share}$$

$$\text{Then, } \frac{2720 - 544}{160} = \frac{2176}{160} = 13 \text{ d. } 60 \text{ cts. a sailor's share}$$

$$16. \text{ As } 6 : 100 :: 972 \text{ dolls. : } 16200 \text{ dolls. her portion}$$

$$\text{And, as } \frac{3}{5} : 16200 \text{ dollars} :: 1 : 27000 \text{ dollars}$$

Then,  $27000 \div 3 = 9000 \text{ d. int. of the father's estate 1 year}$ *dolls. dolls.*

Lastly, as 6 : 100 :: 9000 : 150000 the father's estate

$$17. (4 \text{ ft. } 6 \text{ in.}) \times (2 \text{ ft. } 9 \text{ in.}) \times (3 \text{ ft. } 4 \text{ in.}) = 41 \text{ sq. ft. } 3 \text{ in.}$$

$$18. \frac{1}{9} + \frac{5}{6} = \frac{2 + 15}{18} = \frac{17}{18} \text{ and } 1 - \frac{17}{18} = \frac{1}{18}$$

$$\text{Then, as } \frac{1}{18} : 12 :: 1 : 12 \times 18 = 216 \text{ feet}$$

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$$19. \frac{112 \times \frac{4}{7}}{3} = \frac{64}{3} = 21\frac{1}{3} \text{ years.}$$

$$20. \text{ As } \frac{9}{20} (= \frac{3}{4} \text{ of } \frac{3}{5}) : 1710 :: 1 : \frac{1710 \times 20}{9} = 3800 \text{ dolls.}$$

$$21. 63^2 \times (\frac{63}{2})^2 = 3969 \times 992,25 = 3938240,25 \text{ product}$$

$$\text{And } (63 \times \frac{63}{2}) - (63 + \frac{63}{2}) = 1984,5 - 95,5 = 1890 \text{ diff.}$$

*mi.**day miles**da. h. min.*

$$22. \text{ As } 68 (= 34 \times 2) : 1 :: 2000 : \frac{2000}{\frac{68}{3}} = 29 \text{ } 9 \text{ } 52\frac{16}{17}$$

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$$23. \quad \begin{array}{c} \text{lb.} \quad \text{times} \quad \text{lb.} \quad \text{C. qr. lb.} \\ 6 : 2 :: 885 (= 7 \ 3 \ 17) : \frac{885 \times 2}{6} = 295 \text{ times} \end{array}$$

$$24. \quad \text{Suppose 1, then } 1 + \frac{2}{3} = \frac{5}{3} \text{ sum}$$

$$\text{And, as } \frac{5}{3} : 1 :: 20 : \frac{20 \times 3}{5} = 12$$

$$25. \quad 21 \times \frac{3}{4} = \frac{63}{4} = 15\frac{3}{4}$$

$$26. \quad \frac{3}{4} \div 15 = \frac{3}{4} \times \frac{1}{15} = \frac{3}{60} = \frac{1}{20}$$

$$27. \quad \frac{3}{5} + \frac{1}{8} = \frac{24 + 5}{40} = \frac{29}{40}$$

$$28. \quad \text{Suppose the number to be 6}$$

$$\text{Then, } 6 \times 3 - 8 = 10 \text{ the whole of his money}$$

$$\text{And, } 6 \times 2 + 3 = 15 \text{ the whole of his money}$$

5 error

$$\text{Again, suppose 10 to be the number}$$

$$\text{Then, } 10 \times 3 - 8 = 22 \text{ his money}$$

$$\text{And, } 10 \times 2 + 3 = 23 \text{ his money}$$

1 error

Errors alike.

$$\text{Now, } \frac{5 \times 10 - 6 \times 1}{5 - 1} = \frac{44}{4} = 11 \text{ children}$$

$$29. \quad \begin{array}{l} \text{Inverse 100 dollars } \} \text{ year } \{ \text{500 dollars inverse} \\ \quad \quad \quad 6 \text{ dollars } \} \quad 1 \quad \{ \text{500 dollars} \end{array}$$

$$\text{Then, } \frac{\cancel{500} \times 100}{6 \times \cancel{500}} = \frac{100}{6} = 16 \text{ years 8 months}$$

$$30. \quad \text{Suppose the number to be 100}$$

$$\text{Then, } \frac{100}{2} + 15 + \frac{100}{3} + 10 = 108\frac{1}{3} \text{ the members}$$

$$\text{But, } 108\frac{1}{3} - 100 = 8\frac{1}{3} \text{ error too little}$$

$$\text{Again, suppose 200 members in all}$$

$$\text{Then, } \frac{200}{2} + 15 + \frac{200}{3} + 10 = 191\frac{2}{3} \text{ the members}$$

$$\text{But, } 200 - 191\frac{2}{3} = 8\frac{1}{3} \text{ error too much}$$

Errors unlike.

$$\text{Lastly, } \frac{200 \times 8\frac{1}{3} + 100 \times 8\frac{1}{3}}{8\frac{1}{3} + 8\frac{1}{3}} = \frac{200 + 100}{1 + 1} = \frac{300}{2} = 150$$

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31.  $360 \text{ deg.} \times 69\frac{1}{2} \text{ miles} = 25020 \text{ miles round the earth}$   
 Then, as 20 miles : 1 day :: 25020 :  $25020 \div 20 = 1251 \text{ days}$   
 Lastly,  $1251 \text{ days} \div 365\frac{1}{4} \text{ days} = 3 \text{ years } 155\frac{1}{4} \text{ days}$

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$$\begin{array}{r} 32. \quad 100 \times 3\frac{1}{4} = 325 \\ \quad 150 \times 4\frac{1}{2} = 675 \\ \quad 204 \times 5\frac{3}{4} = 1173 \\ \hline \end{array}$$

$$454 \quad )2173 (4 \text{ months } 23\frac{1}{2}\frac{3}{4} \text{ days}$$

*da. w. da. w.*

33. As 7 : 1 :: 1 :  $\frac{1}{7}$  A can do alone in one day  
 And, as 12 : 1 :: 1 :  $\frac{1}{12}$  the part B can do in a day  
 Then,  $\frac{1}{7} + \frac{1}{12} = \frac{12+7}{84} = \frac{19}{84}$  the part of the work that they  
 can do in a day, working together  
 Lastly, as  $\frac{19}{84}$  work : 1 day :: 1 work :  $\frac{84}{19} = 4\frac{8}{19}$  days

$$34. \quad \frac{(1,05^7 - 1) \times 400^*}{1,05 - 1} = \frac{,40710042265625 \times 400}{,05} \\ = 3256,80338125 = 3256 \text{ dollars } 80 \text{ cents } 3 \text{ mills}$$

Or thus, by the table, page 86.

$$\begin{array}{r} 1.34009 \times 400 = 536.036 \\ 1.27628 \times 400 = 510.512 \\ 1.21550 \times 400 = 486.200 \\ 1.15762 \times 400 = 463.048 \\ 1.10250 \times 400 = 441.000 \\ 1.05000 \times 400 = 400.000 \\ \hline \end{array}$$

$$\underline{\$3256.796}$$

*mo. dolls. mo. d.*

$$35. \quad \text{As } 12 : 5 :: 4 : 1\frac{2}{3} \text{ and } 100 + 1\frac{2}{3} = 101\frac{2}{3} \quad \text{Then,} \\ \text{As } 3\frac{0.5}{3} (=101\frac{2}{3}) : 100 :: 700 : \frac{100 \times 700 \times 3}{305} = 688 \text{ } 52 \text{ } 4\frac{36}{61}$$

$$* \text{ RULE. } A = \frac{(R^t - 1) \times u}{R - 1}. \quad \text{Here } u = \text{the annuity } R =$$

the ratio or amount of £1, or \$1, in one year as in compound interest;  $t$  = the time for which the annuity is in arrear.  $A$  = the amount of annuity at the end of  $t$  years.



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$$36. \quad \frac{3}{8} + \frac{3}{7} = \frac{21+24}{56} = \frac{45}{56} \text{ and } 1 - \frac{45}{56} = \frac{11}{56} \text{ C's parts}$$

$$\text{Then, as } \frac{11}{56} : 140 :: \frac{3}{8} : \frac{\cancel{56} \times 140 \times 3}{11 \times \cancel{8}} = \frac{2940}{11} = 267 \text{ d. } 27 \frac{3}{11} \text{ c.} \quad \text{A paid}$$

$$\text{And, as } \frac{11}{56} : 140 :: \frac{3}{7} : \frac{\cancel{56} \times 140 \times 3}{11 \times \cancel{7}} = \frac{3360}{11} = 305 \text{ } 45 \frac{5}{11} \text{ B paid}$$

37. Suppose the number to be 12.

Then,  $12 \times 4 + 16 = 64$  his money

And,  $12 \times 6 - 12 = 60$  his money

4 error too little

Again, Suppose 20 to be the number of beggars

Then,  $20 \times 4 + 16 = 96$  his money

And  $20 \times 6 - 12 = 108$  his money

12 error too much

Errors unlike.

$$\text{Then, } \frac{12 \times 12 + 20 \times 4}{12 + 4} = \frac{224}{16} = 14 \text{ beggars}$$

38. As  $18 : 1 :: 1 : \frac{1}{18}$  the part B and C can do in a day working together.

And, as  $11 : 1 :: 1 : \frac{1}{11}$  the part of the work they can do in a day, all working

Now,  $\frac{1}{11} - \frac{1}{18} = \frac{18-11}{198} = \frac{7}{198}$  the part of the work that A can do in a day

Lastly, as  $\frac{7}{198} : 1 :: 1 : \frac{198}{7} = 28 \text{ days } 3 \text{ hrs. } 25 \frac{5}{7} \text{ min.}$

39. Suppose that one dollar was the sum paid by 4 members of Congress—or 5 merchants—or 8 lawyers—or 12 citizens.

doll.          doll.

Then, As  $4 : 1 :: 20 : 5$

$5 : 1 :: 30 : 6$

$8 : 1 :: 24 : 3$

$12 : 1 :: 24 : 2$

\$16

viz: 16 dolls. would then be the whole bill.

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Question 39 continued.

	<i>dolls.</i>	<i>dolls.</i>		5 : 60	paid by the congress
Next, As	16	: 192 ::		6 : 72	' ' merchants
				3 : 36	' ' lawyers
				2 : 24	' ' citizens

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$$40. \quad 28 \times 20 = 560 \text{ square inches}$$

$$14 \times 10 \times 2 = 280 \quad ' \quad '$$

---


$$280 = 1\frac{3}{4} \text{ acres}$$

$$41. \quad 200 \text{ acres} = 32000 \text{ perches} = b$$

$$40 \text{ perches} = a. \quad \text{The rule is,}^*$$

$$\sqrt{\left(\frac{a}{4}\right)^2 + b} - \frac{a}{2} \text{ the short side, and } \sqrt{\left(\frac{a}{4}\right)^2 + b} + \frac{a}{2} \text{ the long side}$$

$$\text{Thus, } \sqrt{\left(\frac{40}{4}\right)^2 + 32000} - \frac{40}{2} = 160 \text{ the short side}$$

$$\text{And, } \sqrt{\left(\frac{40}{4}\right)^2 + 32000} + \frac{40}{2} = 200 \text{ the longer side}$$

$$42. \quad \text{Suppose the side of the square meadow to be 1;}$$

$$\text{Then, } \sqrt{1^2 + 1^2} = \sqrt{2} = 1,4142136 \text{ its diagonal}$$

$$\text{And, } 1,4142136 - 1 = ,4142136 \text{ what the diagonal is more than the side}$$

$$\text{Now say, as } ,4142136 : 1 :: 20 : 48,28426 \text{ the side of the required square in perches. Lastly, square the side, and we get the contents } 2331,37 \text{ perches} = 14a. 2r. 11p. \dagger$$

---

*Solution by Algebra.*

\* Let  $x$  = the short side,  $a$  = the difference of the sides, and  $b$  = the contents in perches

Then,  $(x+a) \times x$  = the contents of the ground in perches.

That is,  $x^2 + ax = b$  by the question. ——— By completing the square we get  $x^2 + ax + \frac{a^2}{4} = \frac{a^2}{4} + b$ ; and by evolution  $x + \frac{a}{2} = \sqrt{\frac{a^2}{4} + b}$ , consequently  $x = \sqrt{\frac{a^2}{4} + b} + \frac{a}{2}$

† Put  $x$  = the side of the square, and  $a = 20$ .

Then, (Euclid 1.47)  $2x^2 = (x+a)^2 = x^2 + 2ax + a^2$  by transposition we get  $x^2 - 2ax = a^2$  and by completing the square  $x^2 - 2ax + a^2 = 2a^2$ , by evolution  $x - a = \sqrt{2a^2}$  hence  $x = a + a\sqrt{2}$ . Now by restoring the value of  $a$  we get  $x$  the side of the square to be  $20 + 20\sqrt{2} = 20 + 20 \times 1,4142136 = 48,284272$  perches in the side the same as above, whence the contents may be readily found.

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43. As 18 : 1 :: 2400(=100) :  $2\frac{4000}{18} = 4\frac{000}{3}$  square ft.

And,  $4\frac{000}{3} \div \frac{88}{2} = 4\frac{000}{3} \times \frac{1}{44} = 1\frac{000}{33}$  feet perpendicular

Then,  $\sqrt{\{44^2 + (1\frac{000}{33})^2\}} = \frac{1}{33}\sqrt{(44^2 \times 33^2 + 1000^2)} = \frac{4}{33}$   
 $\sqrt{(11^2 \times 33^2 + 250^2)} = \frac{4}{33}\sqrt{194269}$  one of the equal sides;  
 consequently  $\frac{88}{33}\sqrt{194269} = 106,85$  &c. the sum required.

Or, decimally.

As, 18 : 1 :: 24000 : 1333,33 &c. square feet

And,  $\frac{1333,33}{44} = 30,303$  &c. the perpendicular

Then,  $2\sqrt{44^2 + 30,303^2} = 2\sqrt{2854,27} = 106,85$  feet

44. Half an acre 80 per.  $\times 30\frac{1}{4} = 2420$  square yards

Then,  $\frac{2420}{,7854} = 3081,23$  the square of the diameter.

Lastly,  $\frac{\sqrt{3081,23}}{2} = \frac{55,5}{2} = 27,75$  yards

45. 114 yards 6 feet = 1032 square feet

Then,  $1032 \div 28 = 36\frac{6}{7}$  feet

46.  $\frac{7 \times 2\frac{1}{2} \times 2}{3} = \frac{35}{3} = 11\frac{2}{3}$  inches

47. 20 feet = 240 inches

And,  $240 \times 1\frac{1}{4} \times 1\frac{1}{4} = 240 \times \frac{5}{4} \times \frac{5}{4} = 6\frac{000}{16} = 375$  cubic inches

Half a ton is 1120 pounds; also, 50 feet = 600 inches

And,  $600 \times \frac{7}{8} \times \frac{7}{8} = 2\frac{9400}{64} = 459\frac{3}{8}$  cubic inches

*cubic in. lb. cubic in. lb.*

Then, as 375 : 1120 :: 459 $\frac{3}{8}$  : 1372

*lb. d. lb. pence L. s. d.*

Lastly, as 1 : 3 $\frac{1}{2}$  :: 1372 : 4802 = 20 0 2

48. Here  $\sqrt{39^2 - 15^2} = \sqrt{1521 - 225} = \sqrt{1296} =$

36 feet standing

Then,  $36 + 39 = 75$  feet the whole height

49. Here work backwards

Thus,  $24 \times 9 = 216$ ;  $\sqrt[3]{216} = 6$ ;  $6 \times \frac{4}{3} = 8$ ;  $8^2 = 64$ ;  $64 - 4 = 60$ ;  $60 \div 5 = 12$ ;  $12 \times 8 = 96$ ; lastly,  $96 \div 7 = 103$ .

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50. First, because that  $\frac{1}{10}$  of the whole contents was drawn out each time, consequently  $\frac{1}{10}$  of the parts was drawn.

Hence, 500 gallons of wine

$$\frac{1}{10} = 50 \text{ subtract}$$

$$450$$

$$\frac{1}{10} = 45$$

$$405$$

$$\frac{1}{10} = 40\frac{1}{2}$$

$$364\frac{1}{2}$$

$$\frac{1}{10} = 36\frac{9}{20}$$

$$328\frac{1}{20}$$

$$\frac{1}{10} = 32\frac{16}{200}$$

$$295\frac{49}{200} \text{ galls. wine}$$

$$\text{And, } 500 - 295\frac{49}{200} \text{ galls. water}$$

Or thus,

Here the several portions of wine drawn off were

$$50, \text{ remains } 450$$

$$\frac{50 \times 450}{500} \text{ remains } 450 - \frac{50 \times 450}{500} = \frac{450^2}{500}$$

$$\frac{50 \times 450^2}{500^2} \text{ remains } \frac{450^2}{500} - \frac{50 \times 450^2}{500^2} = \frac{450^3}{500^2}$$

$$\frac{50 \times 450^3}{500^3} \text{ remains } \frac{450^3}{500^2} - \frac{50 \times 450^3}{500^3} = \frac{450^4}{500^3}$$

$$\frac{50 \times 450^4}{500^4} \text{ remains } \frac{450^4}{500^3} - \frac{50 \times 450^4}{500^4} = \frac{450^5}{500^4}$$

$$\text{Therefore, } \frac{450^5}{500^4} = \frac{18452812500000}{62500000000} = 295\frac{49}{200} \text{ gallons of wine}$$

$$\text{Consequently, } 500 - 295\frac{49}{200} = 204\frac{151}{200} \text{ galls. of water}^*$$

\* Analytically. Put  $500=c$ ,  $50=d$ ,  $5=t$ , and  $x$ =what wine remains after drawing  $t$  times

'Then,  $c-d$  expresses the quantity of wine left after the first drawing;  $c : c-d :: d : \frac{(c-d) \times d}{c}$  the quantity of wine drawn out at the second drawing, and  $c-d - \frac{(c-d) \times d}{c} = \frac{(c-d)^2}{c}$  the quantity of wine left after the second drawing.

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$$51. \quad \frac{2 \times 2 \times 4}{4 \times 4 \times 8} = \frac{16}{128} = \frac{1}{8} \text{ part}$$

52. 1817, April 1st. principal 1864 dollars

Oct. 15th 1864 doll. mult. by 197 days = 367208

Paid 225,50

1818 Jan. 10th 1638,50  
Paid 188,86

$$\times 87 = 142549,5$$

May 16th 1449,64  
Paid 585

$$\times 126 = 182654,64$$

Aug. 1st. 864,64  
Interest 126,49

$$\times 77 = 66577,28$$

$$6|0)75898|9,42$$

Balance \$991,13

Interest \$126,49

$$53. \quad \frac{36 \times 6\frac{1}{2} \times 8\frac{3}{4}}{128} = \frac{2047\frac{1}{2}}{128} = 15\frac{255}{256} \text{ cords}$$

Continuation of Note on p. 134.

Also,  $c : \frac{(c-d)^2}{c} :: d : \frac{(c-d) \times d}{c^2}$  the quantity of wine drawn out at the third drawing.

And,  $\frac{(c-d)^2}{c} - \frac{(c-d)^2 \times d}{c^2} = \frac{(c-d)^3}{c^2}$  = the quantity of wine left after the third drawing; and universally—

$c : \frac{(c-d)^{t-1}}{c^{t-2}} :: d : \frac{(c-d)^{t-1} \times d}{c^{t-1}}$  = the quantity of wine drawn out at the  $t$  drawing.

And,  $\frac{c-d}{c} - \frac{(c-d)^{t-1}}{c^{t-1}} = \frac{(c-d)^t}{c^t} = x$  = the quantity of wine

remaining after the  $t$  drawing. By substituting the values of  $c$ ,  $d$ , and  $t$ , in this formula, we get

$$\frac{(500-50)^5}{500^4} = \frac{450^5}{500^4} = 295\frac{49}{200} \text{ galls. of wine the same as above.}$$

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$$54. \text{ As } \overset{\text{days}}{365} : \overset{\text{dolls. cts.}}{356 \text{ } 34} :: 1 : \overset{\text{day}}{97 \text{ cents } 6\frac{2}{3} \text{ mills}}$$

$$55. \text{ As } \overset{\text{cts.}}{18\frac{3}{4}} : \overset{\text{doll.}}{1} :: \overset{\text{dolls. cts.}}{2564 \text{ } 95\frac{1}{2}} : \overset{\text{dolls. cts.}}{13679 \text{ } 76}$$

$$56. \text{ Inverse } 8 \text{ men } \left. \begin{array}{l} \text{ } \\ \$20,50 \end{array} \right\} \overset{\text{days}}{30} \left\{ \begin{array}{l} 64 \text{ men inverse} \\ 100 \text{ dollars} \end{array} \right.$$

$$\text{Then, } \frac{30 \times \overset{25}{\cancel{8}} \times \overset{125}{\cancel{100000}}}{\overset{\cancel{64}}{8} \times \overset{\cancel{2050}}{41}} = \frac{30 \times 25}{41} = 18\frac{12}{41} \text{ days}$$

$$57. \text{ Inverse } 34 \text{ men } \left. \begin{array}{l} \text{ } \\ 1 \text{ bridge} \end{array} \right\} \overset{\text{months}}{6} \left\{ \begin{array}{l} 86 \text{ men inverse} \\ 2 \text{ bridge} \end{array} \right.$$

$$\text{Then, } \frac{6 \times 34 \times \cancel{2}}{\cancel{86} \times 1} = \frac{204}{43} = 4\frac{32}{43} \text{ months}$$

58. As 4 : 6 :: 7 :  $10\frac{1}{2}$  = 10,5 dollars C must pay when A pays 5 dollars and B 7 dollars.

$$\text{And, } 5 + 7 + 10\frac{1}{2} = 22\frac{1}{2} = 22,5 \text{ dollars}$$

$$\text{Lastly, as } \overset{\text{dolls.}}{22,5} : \overset{\text{dolls.}}{240} :: \left\{ \begin{array}{l} 5 : \$ 53 \text{ } 33\frac{1}{3} \text{ A receives} \\ 7 : \$ 74 \text{ } 66\frac{2}{3} \text{ B } \\ 105, : \$ 112 \text{ } 00 \text{ C } \end{array} \right.$$

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$$59. \text{ As } \overset{\text{dolls. cts. ms.}}{100 : 7 \text{ } 3} :: \overset{\text{dolls. cts.}}{8564 \text{ } 20} : \overset{\text{dolls. cts.}}{6 \text{ } 25} + \text{tax}$$

60. (4 galls. 2 qt.)—(2 galls. 2 qt. 1 pt.)=1 gall. 3 qt. 1 pt.=15 pints gained, or remaining in the vessel at the end of one hour.

$$\text{And, } 84\frac{1}{2} \text{ gallons is } 676 \text{ pints}$$

$$\text{Then, as } 15 \text{ pts. : } 1 \text{ hr.} :: 676 \text{ pints : } 45 \text{ hours } 4 \text{ minutes}$$

$$61. \text{ One acre } \overset{\text{P.}}{160} \times \overset{\text{ft.}}{16,5} \times \overset{\text{ft.}}{16,5} = \overset{\text{sq. feet}}{160 \times 272\frac{1}{4}} = 43560$$

$$\text{Then, } 43560 \div 36 = 1210 \text{ feet} = 73\frac{1}{3} \text{ perches}$$

$$62. \text{ 50 men } \left. \begin{array}{l} \text{ } \\ 30 \text{ days} \end{array} \right\} \overset{\text{bushels}}{12} \left\{ \begin{array}{l} 40 \text{ men} \\ 90 \text{ days} \end{array} \right.$$

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Question 62 continued.

$$\text{Then, } \frac{12 \times 40 \times \cancel{88}}{50 \times \cancel{88}} \times \frac{12 \times 4 \times 3}{5} = \frac{144}{5} = 28\frac{4}{5} \text{ bushels}$$

63. Suppose

$$\text{Boy } 1 \times 6 = 6 \text{ cents}$$

$$\text{Women } 3 \times 8 = 24 \text{ '}$$

$$\text{Men } 6 \times 16 = 96 \text{ '}$$

126 cents

$$\text{Then, as } \begin{matrix} \text{cents} & \text{cents} \\ 126 & : & 1890 \end{matrix} :: \left\{ \begin{array}{l} 6 : 90 \text{ cents the boys get} \\ 24 : 360 \text{ cents the women get} \\ 96 : 1440 \text{ cents the men get} \end{array} \right.$$

$$\left. \begin{array}{l} \text{Consequently, } 90 \div 6 = 15 \text{ boys} \\ \phantom{\text{Consequently, }} 360 \div 8 = 45 \text{ women} \\ \text{And } 1440 \div 16 = 90 \text{ men} \end{array} \right\}$$

$$64. \quad 7 \times 4\frac{1}{2} - 8 \times 3 = 31\frac{1}{2} - 24 = 7\frac{1}{2} \text{ miles apart in one day}$$

$$\text{Then, as } 1 \text{ day} : 7\frac{1}{2} \text{ mi.} :: 13 \text{ days} : 97\frac{1}{2} \text{ miles apart}$$

$$65. \quad \begin{array}{r} 962 \times 6 = 5772 \\ 320 \\ \hline \end{array}$$

$$\begin{array}{r} 1635 \times 3\frac{1}{2} = 5722,5 \\ 408\frac{5}{4} \\ \hline \end{array}$$

$$1282 \times 6 = 7692$$

$$1226\frac{1}{4} \times 5 = 6131,25$$

$$\text{A } 13464$$

$$\text{B } 11853,75$$

$$\text{A } 13464$$

$$\text{B } 11853,75$$

$$25317,75 \quad \text{Then,}$$

$$\text{As } 25317,75 : 486 \text{ 64} :: \left\{ \begin{array}{l} \text{dolls. cts.} \quad \left\{ \begin{array}{l} 13464 : 258,79,5\frac{18465}{33757} \\ 11853,75 : 227,84,4\frac{15292}{33757} \end{array} \right. \end{array} \right.$$

$$\text{Proof } \$486,64$$

$$66. \quad \text{Here } \frac{5280^3 \times 2^3}{2500 \times 6 \times 5280 \times 3} =$$

$$\begin{array}{r} 44 \qquad 352 \\ \cancel{288} \qquad \cancel{1056} \\ \hline \cancel{288} \times \cancel{288} \times \cancel{288} \times 8 = 44 \times 352 \times 8 = 123904 \\ \hline \cancel{288} \times \cancel{8} \times \cancel{288} \times \cancel{3} = 25 \qquad \qquad \qquad 25 \\ \hline \cancel{128} \\ 25 \end{array}$$

$$= 4956\frac{4}{5} \text{ hours} = 206 \text{ days } 12 \text{ hours } 9 \text{ min. } 36 \text{ seconds}$$

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$$67. \quad 45\frac{1}{2} \text{ ft.} - 9\frac{1}{2} \text{ in.} = 546 \text{ in.} - 9\frac{1}{2} \text{ in.} = 536\frac{1}{2} \text{ inches}$$

$$\text{And } 9\frac{1}{2} \text{ in.} - 6\frac{3}{4} \text{ in.} = 2\frac{3}{4} \text{ inches gained in a day}$$

$$\text{Now, } 536\frac{1}{2} \div 2\frac{3}{4} = \frac{1073}{2} \times \frac{4}{11} = 2\frac{146}{11} = 195\frac{1}{11} \text{ days}$$

That is, it will be within  $9\frac{1}{2}$  inches of the top in  $195\frac{1}{11}$  days.  
Consequently it will get to the top in  $196\frac{1}{11}$  days.

$$68. \quad \frac{1}{2} + \frac{1}{5} + \frac{1}{8} + \frac{1}{9} = \frac{180 + 72 + 45 + 40}{360} = \frac{337}{360}$$

$$\text{And } 1 - \frac{337}{360} = \frac{23}{360} \text{ Then,}$$

$$\text{As } \frac{23}{360} : 46 :: 1 : \frac{46 \times 360}{23} = 720 \text{ trees}$$

69. Suppose 200 dolls. Again, Suppose 300 dollars

94

94

106

206

$$\frac{1}{2} \text{ of } 106 = 53 \text{ lent}$$

$$\frac{1}{2} \text{ of } 206 = 103 \text{ lent}$$

$$\frac{1}{5} \text{ of } 106 = 21\frac{1}{5} \text{ clothes}$$

$$\frac{1}{5} \text{ of } 206 = 41\frac{1}{5} \text{ clothes}$$

$$94 \text{ debts}$$

$$94 \text{ debts}$$

$$\text{\$}168\frac{1}{5} \text{ sum gone}$$

$$\text{\$}238\frac{1}{5} \text{ sum gone}$$

$$\frac{9}{10} \text{ of } 200 = 180$$

$$\frac{9}{10} \text{ of } 300 = 270$$

$$11\frac{4}{5} \text{ error too much}$$

$$\text{error } 31\frac{4}{5} \text{ too much}$$

Errors alike.

$$\text{Then, } \frac{200 \times 31\frac{4}{5} - 300 \times 11\frac{4}{5}}{31\frac{4}{5} - 11\frac{4}{5}} = \frac{6360 - 3540}{20} = 141 \text{ dolls.}$$

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$$70. \quad \frac{1}{3} - \frac{1}{4} = \frac{4-3}{12} = \frac{1}{12}$$

$$\text{Then, as } \frac{1}{12} : 84 :: 1 : 84 \times 12 = 1008$$

71. Here  $3 - 2 : 4 \text{ ft.} :: 3 : 12$  feet the semidiameter of the circle that the outer wheel makes. Consequently  $12 \times 2 = 24$  feet the diameter of the outer circle.

And,  $24 - 4 \times 2 = 16$  feet the diameter of the inner circle

Lastly,  $24 \times 3,1416 = 75,3984$  feet by the outer wheel

And,  $16 \times 3,1416 = 50,2656$  feet by the inner wheel



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72. Here\*  $1\frac{2}{3}$  = one of the equal sides,  $1\frac{2}{3}$  = half the sum of the sides

$$\text{And } 1\frac{2}{3} - 1\frac{2}{3} = \frac{375 - 250}{6} = \frac{125}{6} \text{ one of the equal rem.}$$

$$\text{Then, } \sqrt{1\frac{2}{3} \times \frac{125}{6} \times \frac{125}{6} \times \frac{125}{6}} = \frac{125^2}{6} \sqrt{\frac{1}{12}} = \frac{125^2}{6} \times \frac{1}{6} \sqrt{3} =$$

$$\frac{125^2}{6^2} \sqrt{3} = \frac{15625}{36} \sqrt{3} = \frac{15625 \times 1,7320508}{36} =$$

751,75816 square feet.

Or, by RULE II, thus;  $125 \div 3 = 1\frac{2}{3}$  is one of the equal sides of the triangle, and because the triangle is equilateral, and consequently equiangular, the included angle of any two sides is  $60^\circ$ , whose natural sine is ,8660254

$$\text{Hence, } 1\frac{2}{3} \times 1\frac{2}{3} \times ,8660254 = 751,7581596 \text{ square feet}$$

\* Here data is given to find the sides.

The rule for solving this question, and all of a similar kind, is by mensuration, as follows:

1. From half the sum of three sides subtract each side severally.
2. Multiply the half sum and the three remainders continually together, and the square root of the product will be the area required.

RULE II. Any two sides of a triangle being multiplied together, and the product again by half the natural sine of their included angle, will give the area of the triangle.

That is,  $AC \times CB \times \text{natural sine of the angle } C = \text{twice area.}$



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